WAR DEPARTMENT TECHNICAL MANUAL

TM E11-219

DIRECTORY OF GERMAN RADAR EQUIPMENT

WAR DEPARTMENT • APRIL 1945

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Refer to FM 21-6 for explanation of distribution formula.

FOREWORD

PURPOSE OF MANUAL

This manual presents a condensation and compilation of the data available at the present time on German radar equipment. It is intended to be of service for recognition purposes and also to aid in the identification of components. It is issued in loose-leaf form, in order that additional sheets or revisions of old sheets can be issued as later information is obtained.

GERMAN RADAR NOMENCLATURE

According to one authority*, the backbone of the German radar system is the *Freya*, a name applied by the German Air Force to several models of transportable, early-warning equipment. From the same source the following information on nomenclature is obtained. The Freya was originally known as *DT* equipment, since the German equivalent of the term radar is DT, or *Dete*. Later, the various models were distinguished, *Dete-Gerät* (radar set) *I* being the 1939 version and *Dete-Gerät II* the 1940 model. The official designations for these are:

DT I: FuMG (Flum) 39G (fB)
DT II: FuMG (Flum) 40G (fB)

Actually, these designations are abbreviated descriptions of the equipment. FuMG (Funkmessgerät), sometimes written *FMG*, is the common term for radar equipment. *Flum* (Flugmeldung) expresses the particular use of this set, namely, aircraft reporting. The numbers 39 and 40 refer to the design years of these two models, and the *G* denotes Gema, the manufacturer. The small letter *f* probably designates an equipment operating in the 2.4-meter waveband and the final *B* stands for Bodenanlage—shore-based equipment.

Minor differences between specimens are expressed in the actual type numbers. For instance, within the Dete I series, these numbers occur:

Equipment serial number	*Type number*
32, 34, and 36	204, 204/1
40, 42, 44, 45, 46	204/3
47 to 58	206/1

A typical designation for a Pole type Freya is:

FuMG (Flum) 40G (fZ)
in LZ mounting number 87=f 344

It will be noted that this equipment is similar to the DT II, and also that it is attributed to Gema. Since the equipment is demountable (Zerlegbare), however, *Z* has taken the place of *B*, and the equipment is specifically stated to be built into an LZ mounting. The f 344 is the serial number of the actual set and has no systematic relation to the LZ serial number. This *f* number is normally, and the LZ number more rarely, painted on each of the main component units of the radar set. These numbers are not always changed when a unit is returned for repair to the base workshop and reissued to another station. It is therefore not unusual to find after a time a selection of *f* numbers on any one unit. Units may also be found bearing their history in the shape of a series of *f* or LZ numbers.

COMPONENT NOMENCLATURE

The major components of Freya equipment are designated by the following arbitrary series of letters:

Z = Summer = Audio oscillator + phase shifters, etc.
T = Main transmitter + modulator.
Q = IFF interrogator transmitter + modulator.
N = Main receiver + coarse presentation.
O = Precise ranging unit + presentation.
P = IFF receiver.
V = Transmitting antenna frame.

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* Air Scientific Intelligence Report No. 26, A.D.I. (Science).

W = Receiving antenna frame.
R = Power packs.
X = Test set.

Two-letter designations are assigned to the subunits of each major component, but this nomenclature follows a definite system. The first letter denotes the major component of which the subunit forms a part, while the second gives a clue to the function of the subunit. For example:

TS = Steuerteil = Transmitter modulator.
TN, RN = Netzteil = Local power pack.
PE, NE = Empfangsteil = Receiver.
OB, NB, PB = Beobachtungsteil = Presentation unit.
OK = Messkette = Ranging unit.
RH = Hochspannungsteil = High voltage unit.
RI = Instrumententeil = Control + instrument panel.
WA, NA = Abstimmungsteil = Tunable part of antenna or receiver.
NZ = Zwischenfrequensteil = i-f amplifier and 2d detector.
TU = Ultrateil = Transmitter r-f stage.
PU = Umschalter = Split switch.
GU = Kuhlgerät = Transmitter cooling fan.

In addition, each unit and subunit has a type number. These numbers, in general, are not interchangeable; they may form part of some totally different, though related, equipment. For example, the receiver subunit NA 100 is the commonest Freya receiver r-f section and works in the 125- mc band, whereas the NA 101 is used in Coastwatcher equipment and operates on about 375 mc. Each equipment, however, uses the same i-f section NZ 102. It is therefore important that any component under consideration be specified by its full type designation.

ACKNOWLEDGMENTS

This manual is based on information furnished by the Intelligence Branch, Plans and Operations Division, Office of the Chief Signal Officer. Pictures of the FuG 25A, the FMG 39T (D) Würzburg, and the Freya transmitter and tone generator were furnished by Camp Evans Signal Laboratory.

It is believed that users of this volume will find helpful TM 30–490, German-English Glossary. Technical Communication Terms, 22 December 1943.

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AIRBORNE RADAR

FuG 25 AIRBORNE IFF TRANSMITTER-RECEIVER

The FuG 25 equipment is carried in an aircraft to notify short-range ground radar stations (Würzburgs) by coded pulses that the plane is friendly. Manufactured by Lorenz, the FuG 25 has a range of approximately 40 miles, within the range of Würzburgs.

It comprises two units: a transmitter-receiver unit (SE 25) and a tone generator, which includes a motor generator (no tone generator has yet been captured). The receiver-detector is tuned to the Würzburg frequency of 500 mc (approximately) and the transmitter to the 150- to 160-mc band covered by a special receiver in the Würzburg. Identification is by phone with an auxiliary signal strength meter which allows D/F on minimum signal.

The receiver uses a simple diode circuit followed by three amplifier tubes, the output controlling a three-tube transmitter (oscillator and two amplifiers). A signal input to the receiver of at least 2 millivolts at 30 percent modulation will cause the transmitter to operate at a fixed carrier frequency of 157 mc with a power output of 200 milliwatts. It is believed that the equipment is coded by keying both the carrier and the modulation frequency with a choice of two codes. Operation of a relay lights a neon lamp to inform the pilot that he is being interrogated.

It is believed that the FuG 25 equipment was designed originally for bombers. A captured document states, however, that it was to be used only in day and night fighters of the types Me 109, FW 190, Me 110 F-4, Ju 88 C-6, and Do 217 J/N and that other aircraft so fitted should have antennas and units removed, leaving mountings and permanent wiring untouched. It is believed that this policy has not been adhered to. Actually, FuG 25 fittings have been found only in two-engined fighters. It is thought that this equipment is not in use at the present time.

The characteristics of the FuG 25 are as follows:

RANGE (miles): 40 (approximately).

FREQUENCY RANGE (mc): Interrogates 550 to 580; responds 150 to 160.

PULSE RECURRENCE FREQUENCY (cps): 5,000.

PULSE LENGTH: 2 microseconds.

ANTENNA: Vertical rod 14 inches long, directly connected with receiver feeder and matched to transmitter feeder. Antenna is mounted in vulnerable position; damage to it would open the high-voltage circuit and render the transmitter inoperative.

POWER SOURCE: "Tongeber" (tone generator) and dynamotor in single unit operating from a-c battery.

SIMILAR SETS: None. FuG 25A is a later development.

POWER INPUT REQUIRED: A signal input to the receiver of at least 2 millivolts at 30 percent modulation is required to cause the transmitter to operate at a fixed carrier frequency of 157 mc.

POWER OUTPUT: 200 milliwatts (peak).

TYPE MODULATION: CW transmission is modulated by tone generator and coded in Morse. The receiver is sensitive only to a modulation of 5,000 cps.

TUBES (type and number): Transmitter: one RV 12P 2000 MO, two RV P 2000 in push-pull frequency doubler stage. Receiver: one diode (LG 1) in r-f stage and three RV 12 P 2,000 in l-f stages.

PRINCIPAL COMPONENT

	DIMENSIONS			WEIGHT
	Height	*Width*	*Depth*	
T/R (SE 25) unit	8 in.	5½ in.	6 in.	7 lb. 11 oz.
Total weight				16½ lb.

FuG 25A AIRBORNE IFF TRANSMITTER-RECEIVER

The identification equipment FuG 25A, a modified version of FuG 25, is designed to operate with medium- and long-range ground radar stations (Freyas). Consequently its range, 100 to 150 miles, is much greater than that of the FuG 25. While its primary use is for identification purposes, the FuG 25A is also employed as a bombing-release controller and as a navigational aid.

Manufactured by Gema, the equipment consists of one unit in three sections: transmitter-receiver, code keyer, and power supply. Two preset codes can be selected for the transmitter by inserting two keys in the code keyer. Turning the keys 90° lifts a number of the switches clear of the rotating cams, leaving the remaining switches to form the coding sequence, making and breaking the high-voltage circuit to the limiter tube and thus keying the transmitter. Only one of the switch banks, consisting of 10 parallel contacts, can be selected at a time. Over 1,000 codes in each bank are possible.

The receiver is an eight-tube superheterodyne. The i-f amplifier is tuned to a fixed frequency of 7 mc; the r-f oscillator thus operates 7 mc above the incoming signal frequency band and is swept through the 130- to 135-mc band by a split-stator capacitor connected across the tuned circuit of the oscillator at a speed of about 400 cps. This short-fast sweep of the receiver frequency insures a wide band with sensitive spot-frequency reception.

An h-f tube (type LD 1), capable of operating up to 6,000 mc, is used in the oscillator circuit. Resistors are placed across the i-f transformer windings to insure a bandwidth of 700 kc at 6 db down. When the second detector has a peak signal voltage of at least 2.6 volts at the plate, the trigger tube causes the transmitter to operate and to deliver a narrow pulse of high amplitude to the antenna. High output at low voltage makes the equipment ideal for high altitudes.

The FuG 25A, though airborne, is preset on the ground before the take-off and the Morse recognition signal cannot be changed in the air. When used as a navigational aid, the aircraft is plotted from the ground by responses from the FuG 25A and is given course directions by voice radio, using FuG 16 or the transmitting radio-telephone attachment to FuG 10 which has a longer range than FuG 216. Latest use for the FuG 25A is for remote bombing control, using two Freya stations for a "fix."

Since FuG 25A functions with the German long-range Freya radars, it is to be expected that it would be fitted in all aircraft likely to be employed in attacks on Allied territory in order that they might be identified as friendly on their return journey. Crash examination, however, has shown that very few aircraft operating over Great Britain and the Mediterranean area have ever carried the equipment, although the mounting frame may be fitted. It could easily be installed in many types of aircraft should tactical requirements demand it. The German policy with regard to this equipment is not definitely known.

The characteristics of the FuG 25A are as follows:

RANGE (miles): 100 to 150.

FREQUENCY RANGE (mc): Interrogates 123 to 128; responds 152.2 to 161.0. Transmitter spot frequency 156.0. A received pulsed signal operates the transmitter on a preset frequency within the prescribed range.

PULSE RECURRENCE FREQUENCY (cps): 500 (minimum).

PULSE LENGTH: 0.5 microsecond.

ANTENNA: Vertical rod 14 inches long for both transmitting and receiving through the special antenna matching unit.

TYPE OF PRESENTATION: Visual.

POWER SOURCE: A self-contained rotary

inverter supplies 18 to 20 volts ac at 130 cps to power transformer. It operates on an input of 25 to 28 volts at about 4 amp. The inverter also drives the coding switches through gearing.

SIMILAR SETS: The earlier model FuG 25 (with SE 25). Antenna stub is the same for both sets but antenna matching unit is different.

POWER INPUT REQUIRED: 25 to 28 volts at 4 amp.

POWER OUTPUT (watts): 400 (peaks).

TUBES (type and number): Transmitter: one LS 50 tuned by Lecher system. Receiver: six RV 12 P 2000 and two LD 1.

PRINCIPAL COMPONENTS

	DIMENSIONS			WEIGHT
	Height (*in.*)	*Width* (*in.*)	*Depth* (*in.*)	(*lb.*)
SE 25A (transmitter-receiver)	13	8	5¼	20½
AR 25 (mounting frame)	14	8	2½	
WK 25 (resistance box)	3½	3	2¾	10
VD 25 (junction box)	3½	3½	1	
BG 25 (controller)	3	2¾	2¾	1
Antenna matching unit	4	3½	2	1½
Total weight of components				33

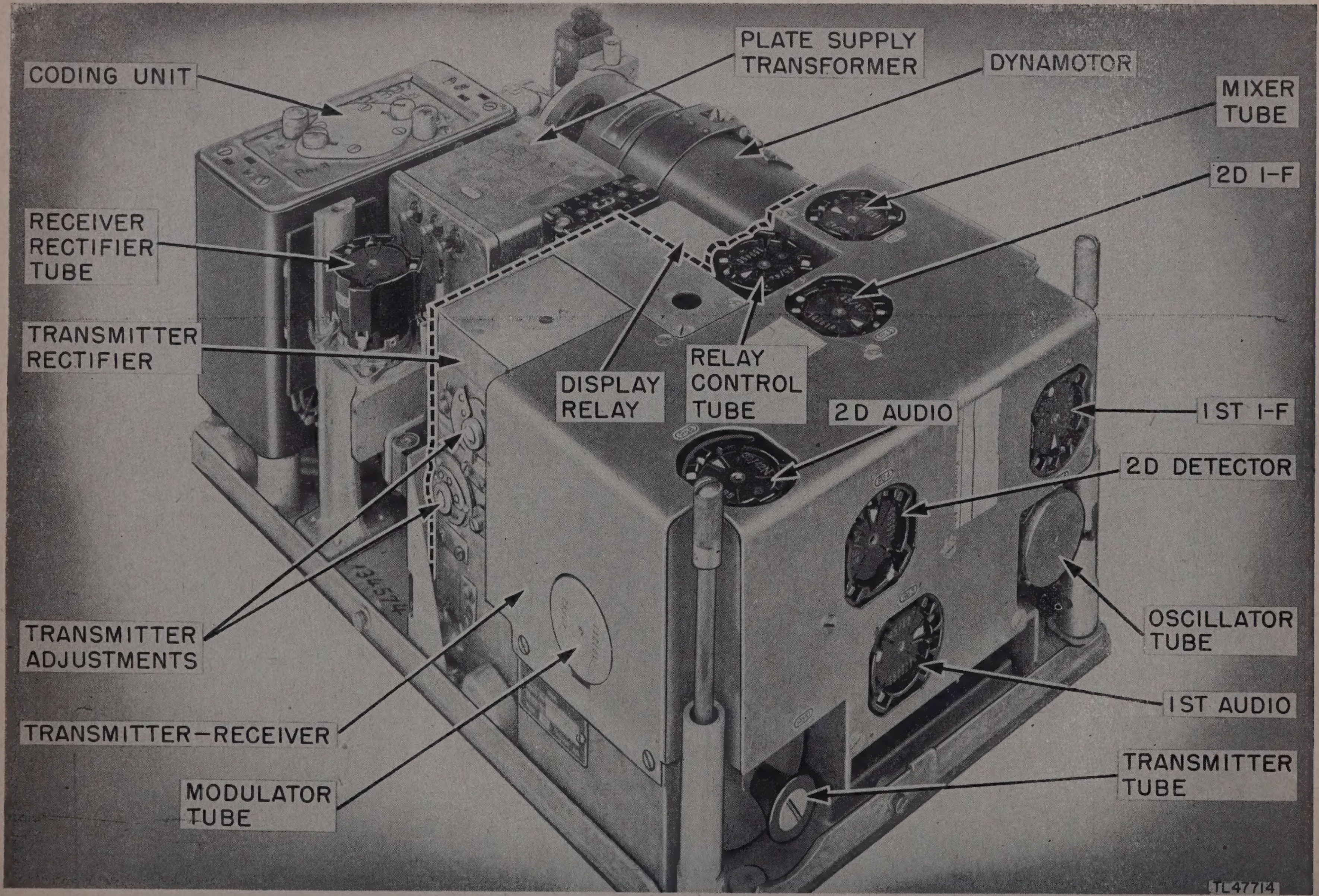

CODING UNIT
PLATE SUPPLY TRANSFORMER
DYNAMOTOR
MIXER TUBE
2D I-F
RECEIVER RECTIFIER TUBE
TRANSMITTER RECTIFIER
DISPLAY RELAY
RELAY CONTROL TUBE
2D AUDIO
1ST I-F
2D DETECTOR
TRANSMITTER ADJUSTMENTS
OSCILLATOR TUBE
1ST AUDIO
TRANSMITTER-RECEIVER
MODULATOR TUBE
TRANSMITTER TUBE
134574
TL47714

Figure 1. FuG 25A airborne IFF.

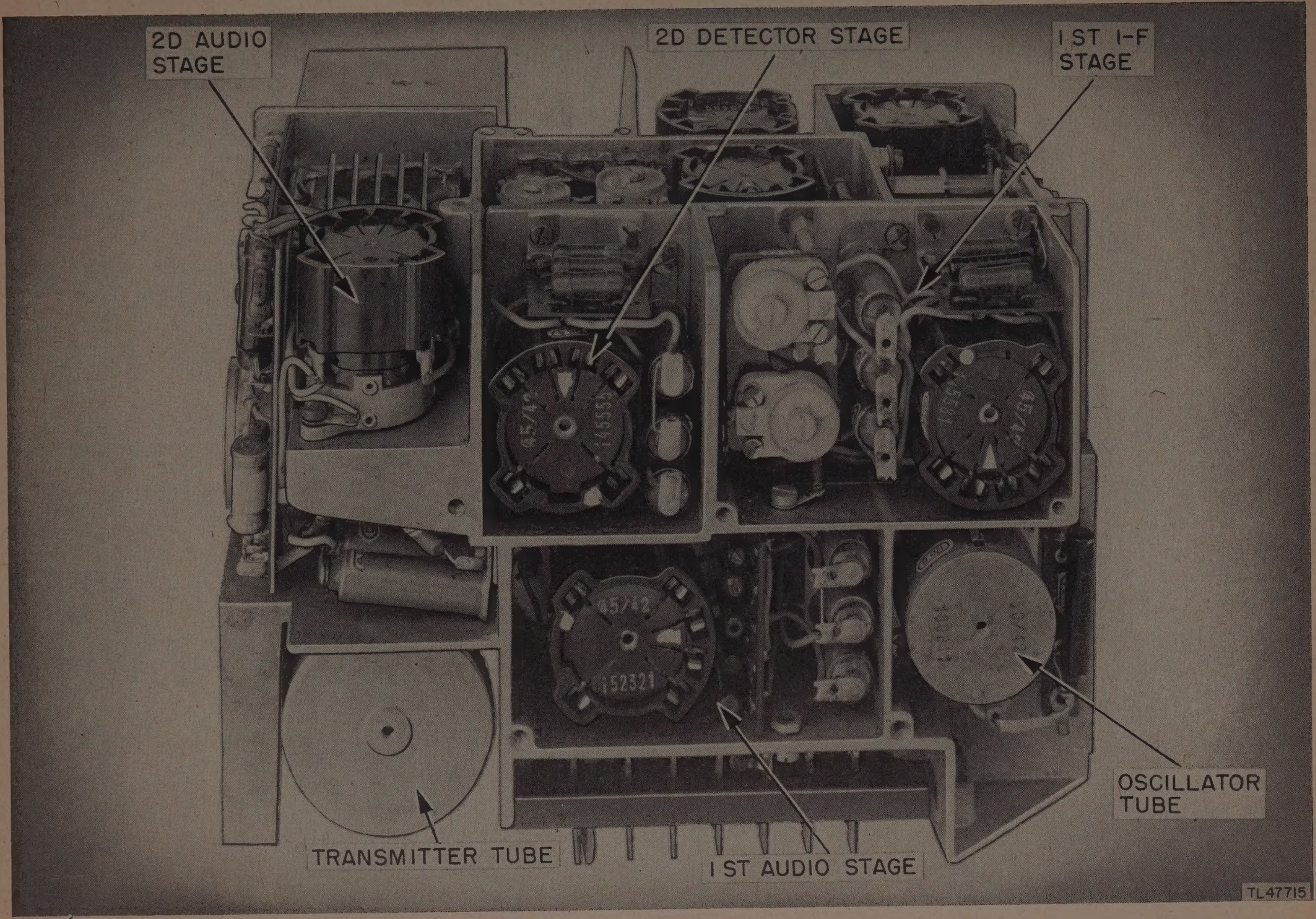

2D AUDIO STAGE
2D DETECTOR STAGE
1 ST I-F STAGE
TRANSMITTER TUBE
1 ST AUDIO STAGE
OSCILLATOR TUBE
TL47715

Figure 2. FuG 25A transmitter-receiver (end view).

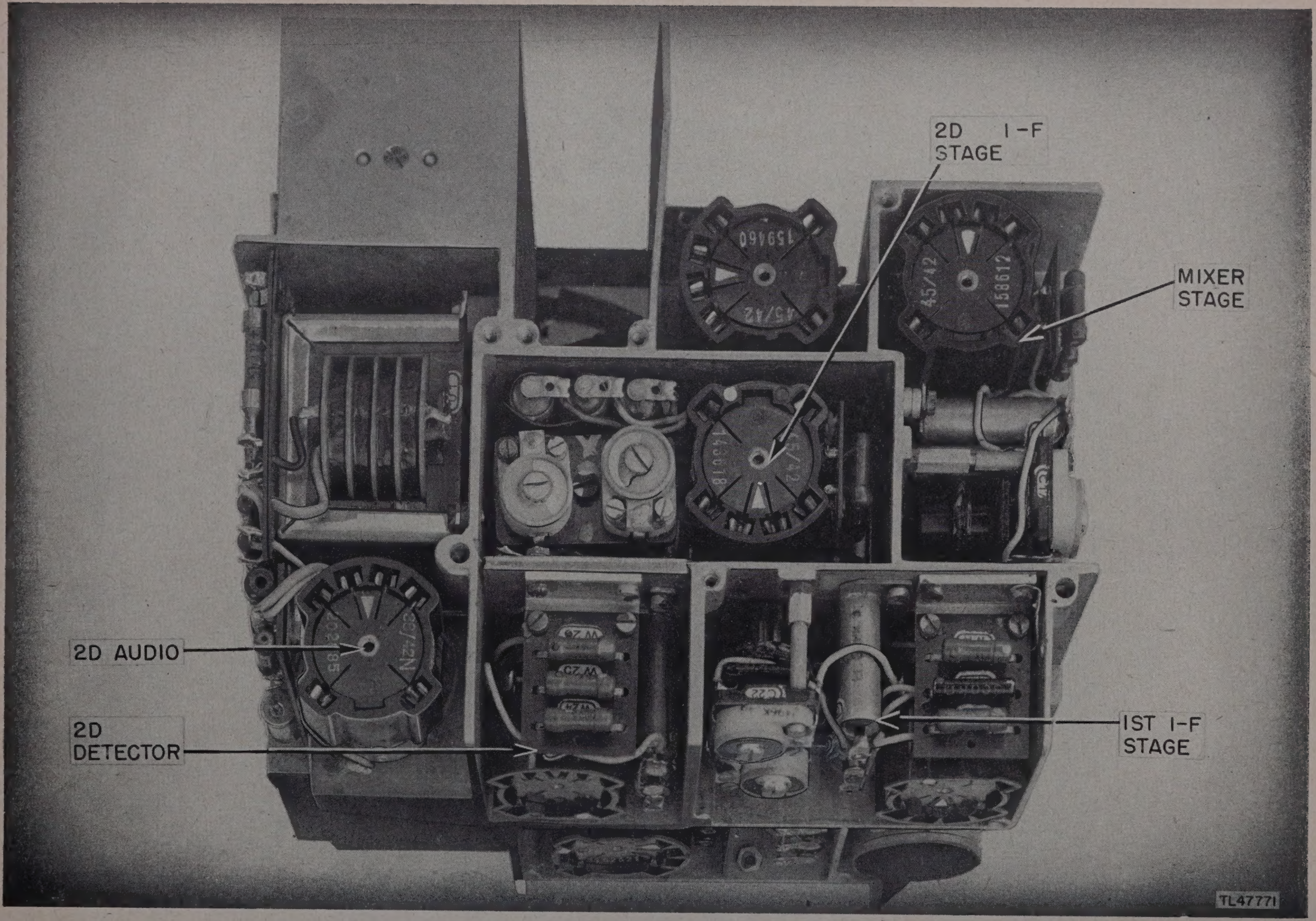

2D I-F
STAGE
MIXER
STAGE
2D AUDIO
2D
DETECTOR
IST I-F
STAGE
45/42
158612
159160
143618
33/42N
202285
W26
W25
W24
C22
TL47771

Figure 3. FuG 25A transmitter-receiver (top view).

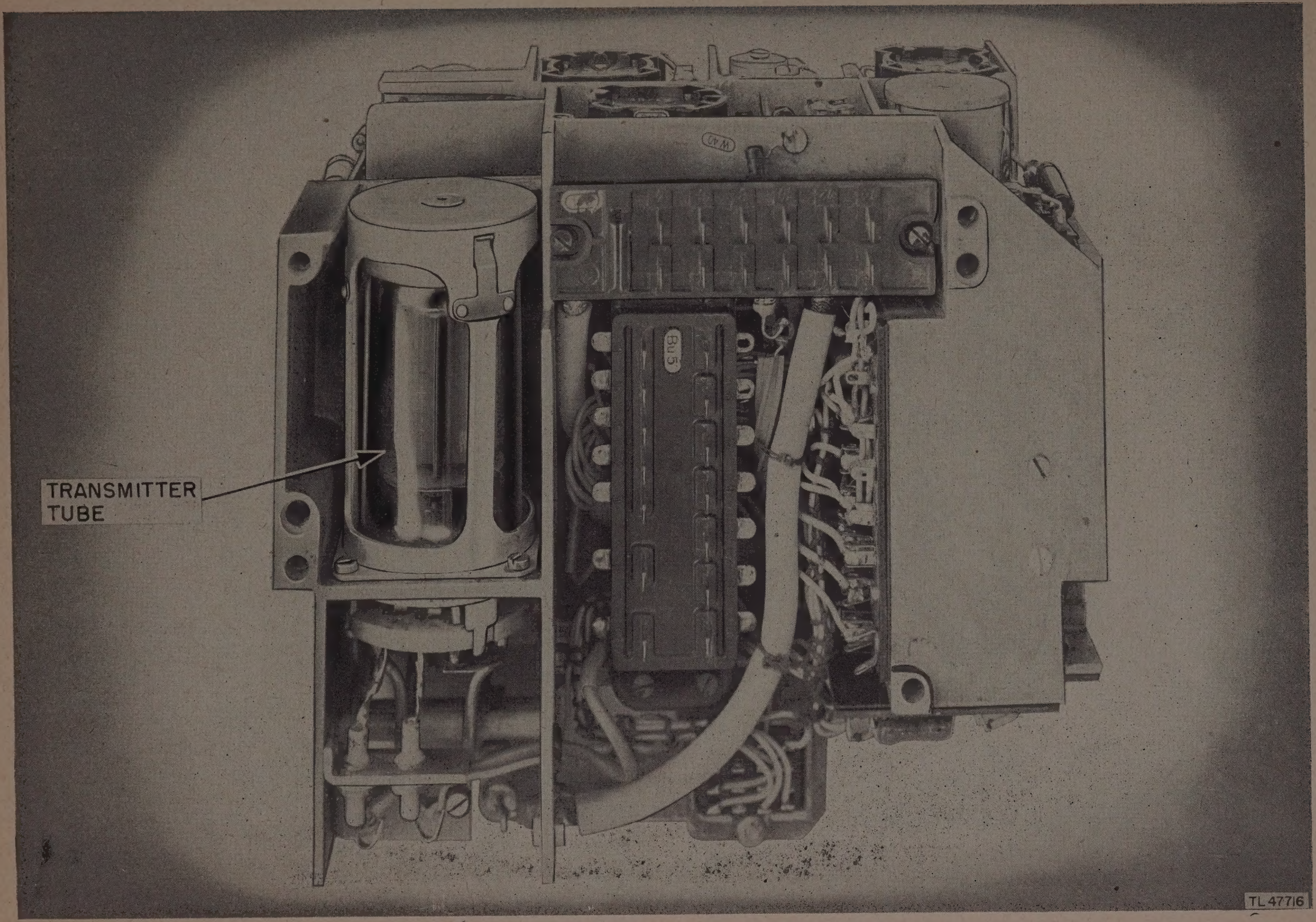
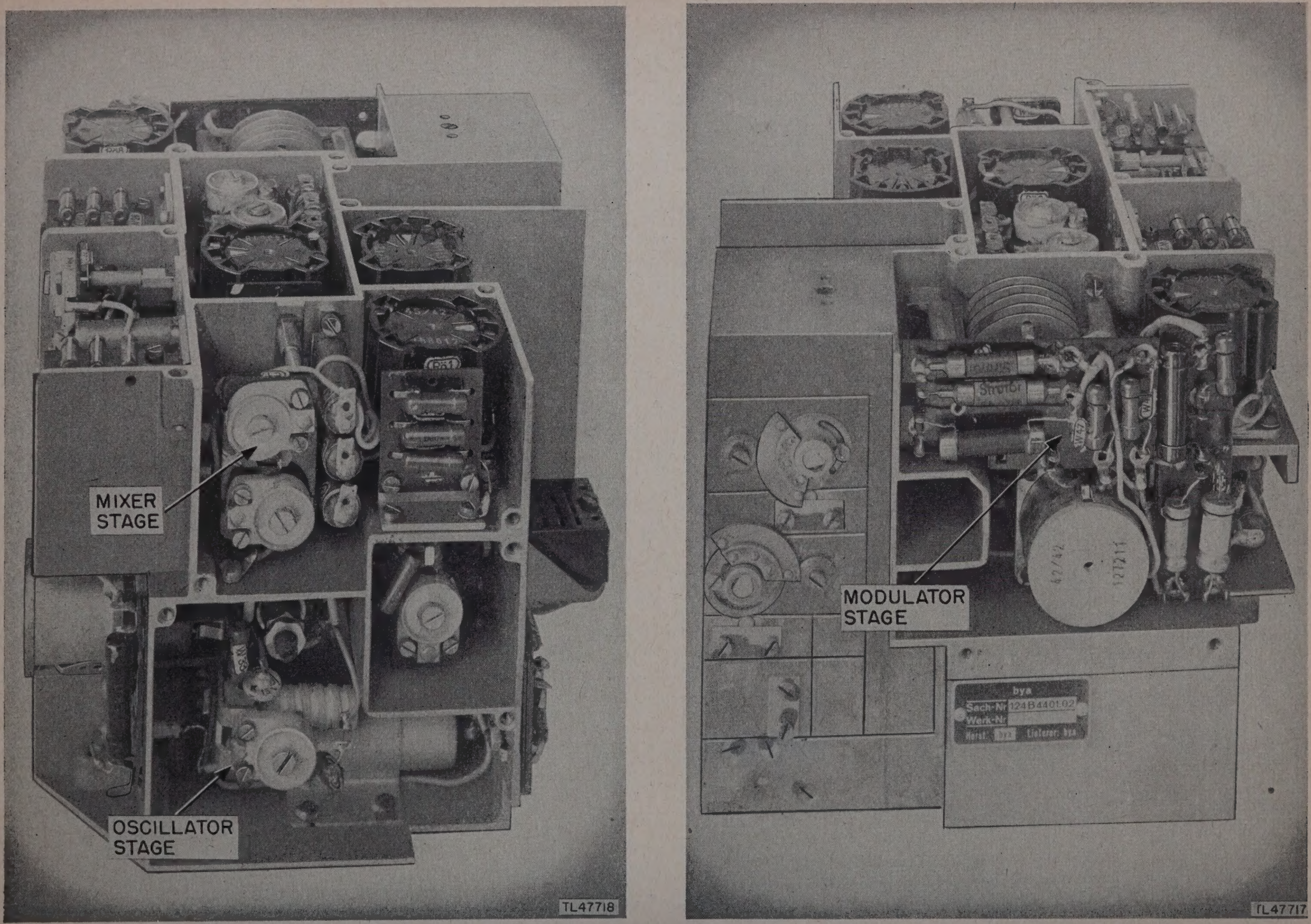

TRANSMITTER
TUBE
Bu 5
W 40
TL 47716

Figure 4. FuG 25A transmitter-receiver (bottom view).


MIXER STAGE
OSCILLATOR STAGE
TL47718
MODULATOR STAGE
TL47717

② ①

Figure 5. FuG 25A transmitter-receiver (side views).

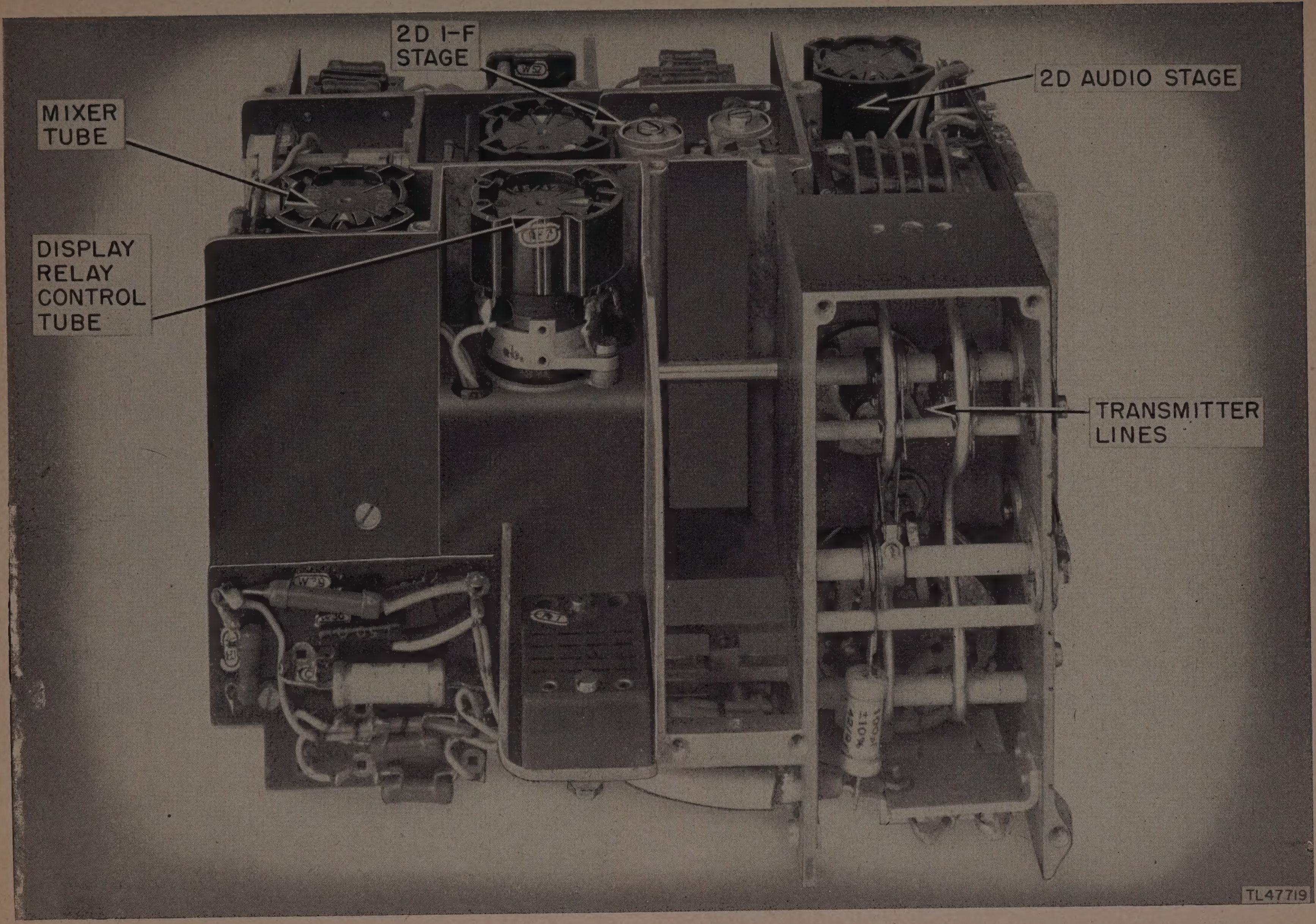

2D I-F STAGE
2D AUDIO STAGE
MIXER TUBE
DISPLAY RELAY CONTROL TUBE
TRANSMITTER LINES
TL47719

Figure 6. FuG 25A transmitter-receiver (end view).

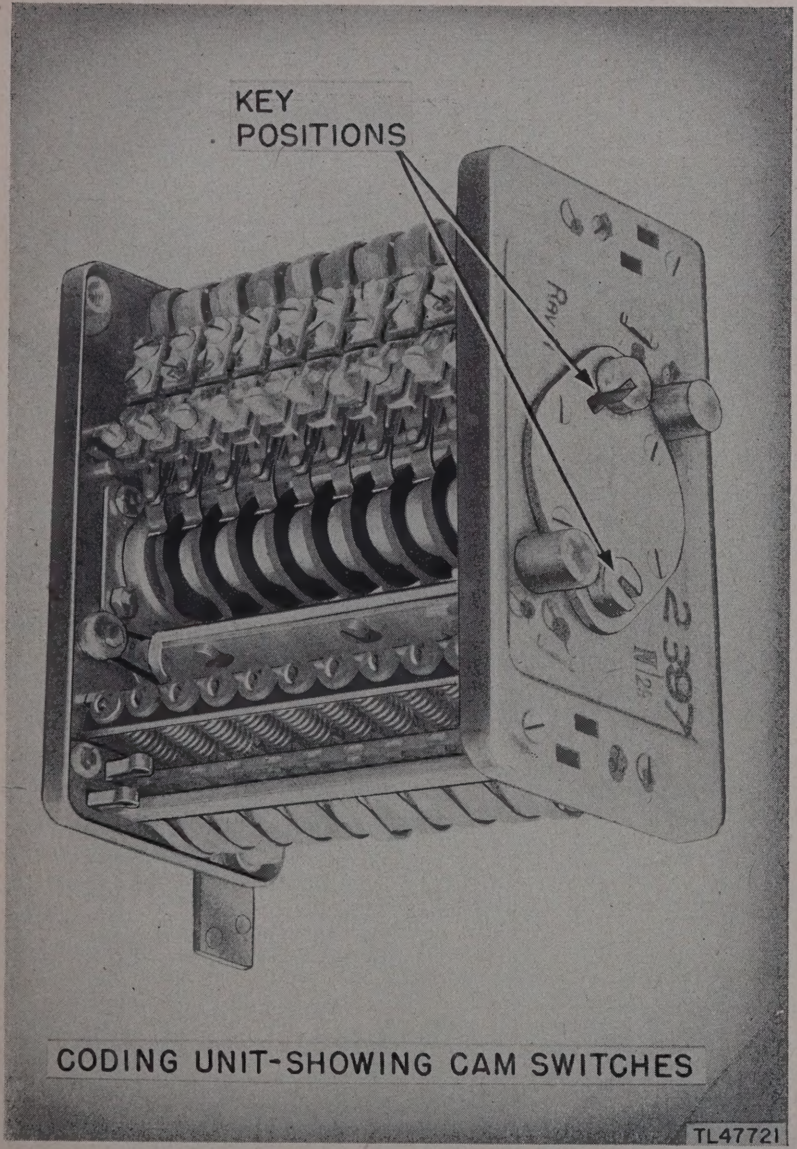

KEY POSITIONS
2 397
N/25
Rav
CODING UNIT-SHOWING CAM SWITCHES
TL47721

Figure 7. Coding unit, showing cam switches.

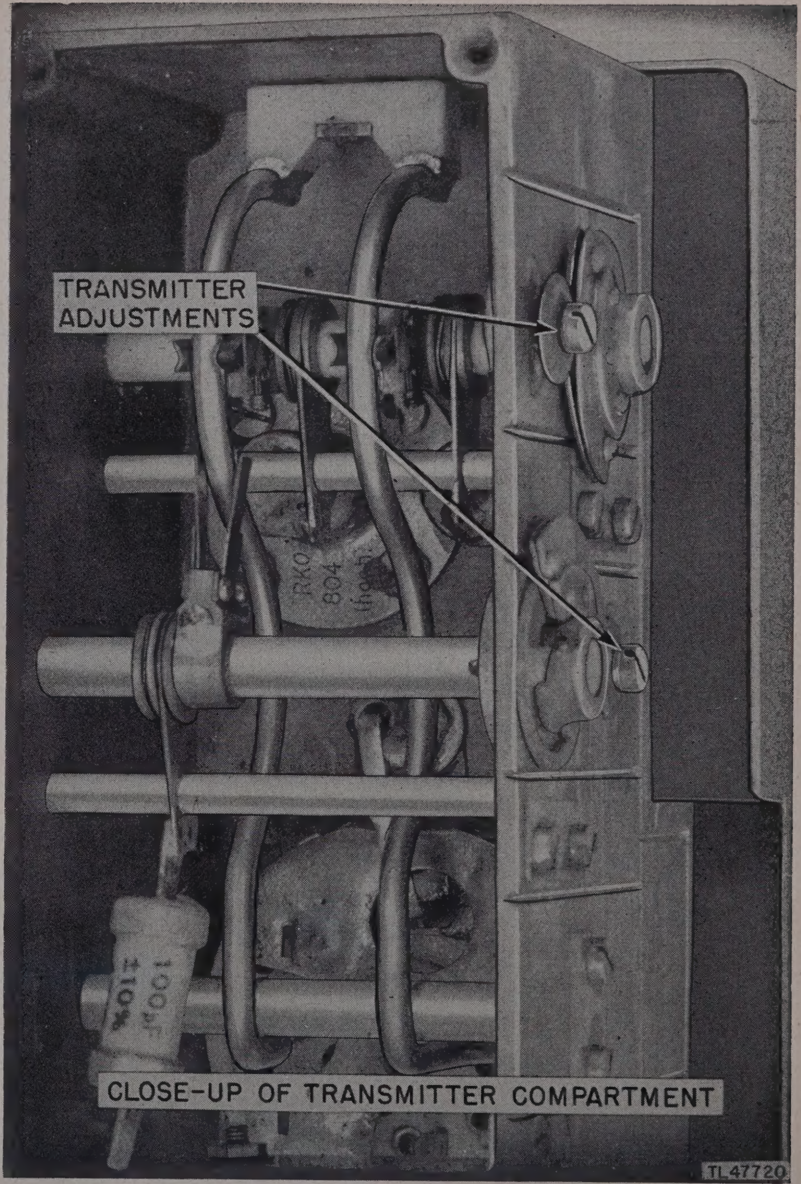

TRANSMITTER ADJUSTMENTS
RKO
804
100pF
±10%
CLOSE-UP OF TRANSMITTER COMPARTMENT
TL47720

Figure 8. FuG 25A airborne IFF.

FuG 200 (HOHENTWIEL) ASV AND NAVIGATIONAL RADAR

FuG 200 (Hohentwiel) is a search and warning equipment and is used for the detection of surface vessels and as a navigational aid.

Manufactured by Lorenz, the FuG 200 consists of a two-tube high-power transmitter, a superheterodyne receiver, and a CRT indicator. The transmitting antenna consists of eight end-fed, half-wave horizontal dipoles arranged in colinear pairs mounted on brackets in front of the fuselage and facing forward in the line of flight. The receiver has no r-f amplification; it is connected, by means of a motor-driven switch, alternately to two antennas fitted on the starboard and port sides of the fuselage at angles of 30° to the line of flight.

Below the observer on the right is a switchbox fitted with four knobs. The top two-way switch turns the equipment on and off. The bottom knob remotely controls the gain in the receiver. The right-hand lever is self-centering and makes a slight adjustment in the frequency. The left-hand switch is used when Hohentwiel is at 2,000 meters* or higher.

The range scale etched on the glass of the CRT screen coincides with the vertical timebase and is calibrated from zero to 150 km at 10-km intervals, the distance between the 10-km marks being progressively smaller as extreme range is reached. Because of ground returns, satisfactory readings cannot be obtained at less than three km. To offset this, some of the FuG 200's have been fitted with a switch by which the scale can be magnified so that close ranges can be read off to the nearest 50 meters. Receiver and transmitter are probably not accessible during flight since a remote control box is provided.

FuG 200 is used in a Ju 88, Ju 188, Ju 290, Heinkel III, FW 200, and Do 217. Late information includes details of a radar of this type which was fitted on a submarine. For blind bombing at night, it is said that best results can be obtained by the combined use of Hohentwiel, X-Gerät Clock, and Altimeter FuG 101, FuG 101A, or FuG 103.

The indicator of a captured Hohentwiel had the following markings:

Sichtgerät S.C. 200
Ln. 28893-2
124-1575-C-1
NR. 2034

The characteristics of FuG 200 are as follows:

RANGE (miles): Approximately 60.

FREQUENCY RANGE (mc): 570; possible band 550 to 570.

PULSE RECURRENCE FREQUENCY (cps): 600.

ANTENNA: In three sections, one for transmitting and two for receiving. Each section consists of eight dipoles and eight reflectors. Transmitting antenna is on nose of aircraft, flanked on each side by receiving arrays that point 30° to left and right of line of flight.

TYPE OF PRESENTATION: Display unit in front of the observer contains CRT with vertical timebase, that is, a screen of perspex sheet metal with 15 parallel horizontal lines reading 0 to 150 km (from bottom to top). Of the four knobs on front panel, the top left controls the zero point; the top right, the focus of the trace; the bottom left changes the range from 0 to 150 km for search and navigational aid to the 0 to 15-km range for approach and attack; the bottom right governs the brightness of the trace.

POWER SOURCE: Motor generator, 500 volts a-c, suplying power packs in each unit.

SIMILAR SETS: Rostock Gerät, an early type of search equipment which has been scrapped and is now superseded by the FuG 200.

POWER INPUT REQUIRED: Not known.

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* One meter = 3.28 feet.

POWER OUTPUT: Not known.

TUBES (type and number): Transmitter: two RD 12 TF, plate-modulated, push-pull with Lorenz tubes RS 323 as alternative. Receiver: one LG 7 as mixer, one LD 1 as local oscillator, four LV 1 as i-f's, two LG 1 as detectors, and two LV 1 as videos.

PRINCIPAL COMPONENTS

	DIMENSIONS			WEIGHT
	Height *(in.)*	*Width* *(in.)*	*Depth* *(in.)*	*(lb.)*
Transmitter and modulator	10½	13¾	8¾	3[illegible]
Indicator unit	8½	9	5½	13[illegible]
Control box	4¼	4¼	2¼	

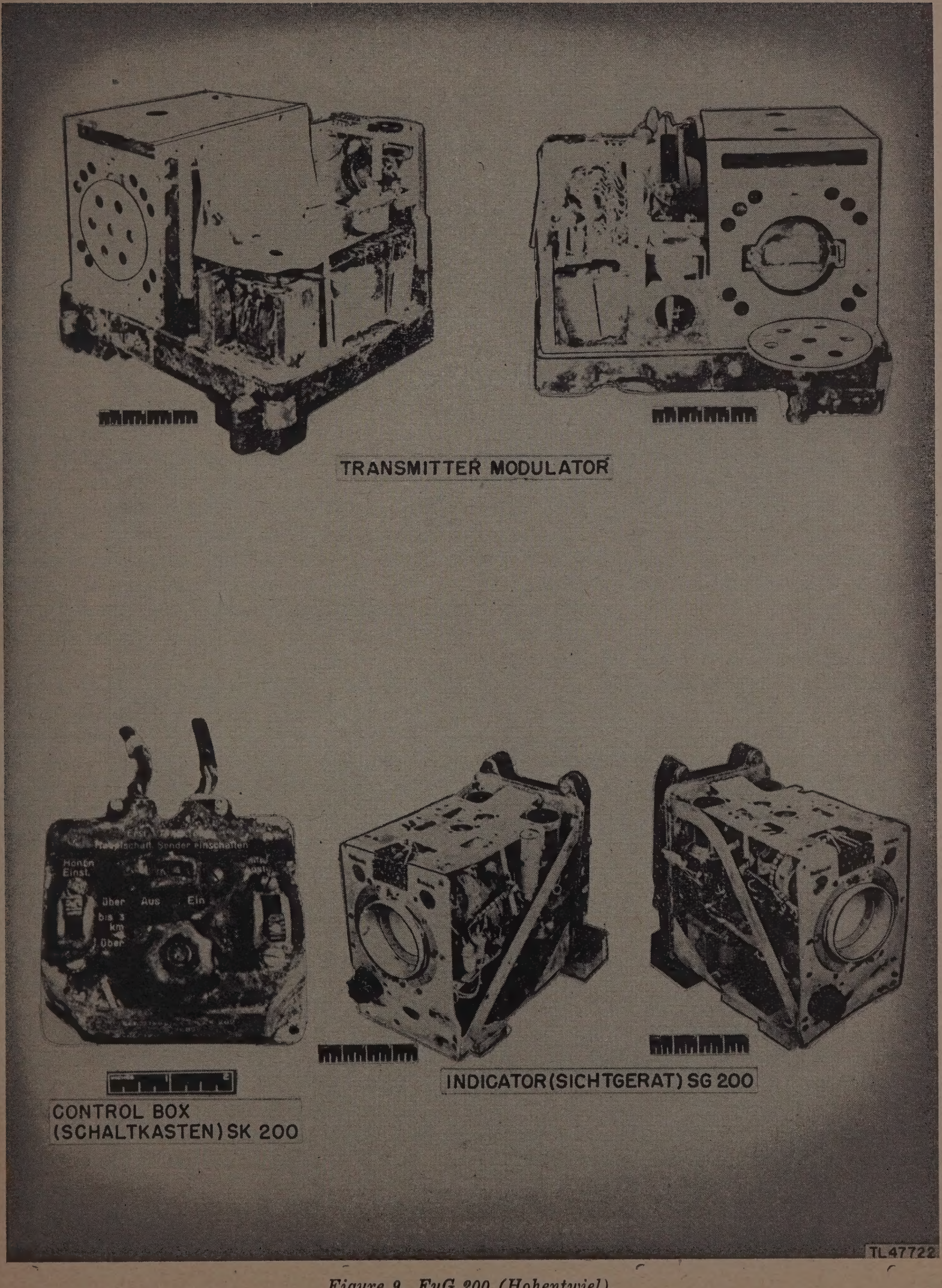

TRANSMITTER MODULATOR
Sender einschalten
Höhen Einst.
Über
Aus
Ein
bis 3 km
Über
CONTROL BOX (SCHALTKASTEN) SK 200
INDICATOR (SICHTGERAT) SG 200
TL47722

Figure 9. FuG 200 (Hohentwiel).

FuG 202 (LICHTENSTEIN) AIRBORNE AI RADAR

FuG 202, manufactured by Telefunken, is the standard, forward-looking air intercept equipment mounted in twin-engined night fighters: Ju 88, Me 110, and Do 217. It is accessible to the wireless operator during flight and consists of a transmitter-receiver mounted on the starboard side of the cockpit at the left of the operator, an indicator unit on the port side adjacent to the operator's seat, antenna system on the detachable nose of the aircraft, and power supply unit on a separate frame attached to the port side aft of the bomb doors. Unit construction is used throughout. The six demountable units mounted on the main panel are the transmitter, modulator, receiver r-f unit, receiver broad-band amplifier, receiver quench generator, and circular timebase and brightening unit.

The transmitter is triggered by the modulator which starts with the master oscillator followed by a cut-off-biased tube with tuned transformer in plate. Sharp peaks from this transformer kick the grid of the third tube; the next kick occurs several cycles later, thus dividing the oscillator frequency by some predetermined figure, usually one-in-seven, though it can be one-in-eleven. After several shaping stages, this pulse is converted to a one-in-five pulse of 1,500 volts and 0.9 ampere applied to the plates of the transmitter tubes, two RS 394 30-watt triodes.

The receiver is superregenerative and consists of r-f unit, quench generator, and wide-band amplifier with automatic gain stabilization circuit. Voltage gain from antenna input to detector output is approximately 160 under average operating conditions. The receiver can be tuned in flight.

The indicator unit contains three CRT's, two for D/F (azimuth and elevation) and the third for range. All timebases are derived from sine waves. Range is circular (with radial deflection) derived from phase-split sine wave.

The very narrow beam of the Lichtenstein is to a great extent offset by high sensitivity to small changes in bearing of the target aircraft. It has excellent D/F accuracy.

The characteristics of the FuG 202 are as follows:

RANGE: Limited by the low-power output to a theoretical range of 5 miles and a practical range of 2 miles.

FREQUENCY RANGE (mc): Transmitter, 410 to 540; receiver, 479 to 499; spot, 490.

PULSE RECURRENCE FREQUENCY (cps): 2,700.

PULSE LENGTH: 1 microsecond.

ANTENNA: Yagi; common T&R in four sections of four half-wave dipoles with parasitic reflectors. Vertical polarization. Antenna beam width for half-lobe amplitude 35 horizontal, 30° vertical. Antenna gain 13 t 14 db (estimated).

TYPE OF PRESENTATION: Three CRT's: two for azimuth and elevation, using linear timebase; one for range, using circular timebase. Elevation tube can show an object 20° above and 30° below line of flight; azimuth tube covers 20° to right or left. Trace brightening is applied to all tubes to prevent multiple traces.

POWER SOURCE: Motor generator U–10s; CRT power supply unit operates from a-c output of motor generator; filter unit for smoothing d-c output of motor generator.

POWER INPUT REQUIRED: Approximately 16 amp at 28 volts.

POWER OUTPUT (watts): 450 (peak).

TYPE MODULATION: Pulse with triggering.

TUBES (type and number): Total of 29 tubes of the following types: twelve RV 12 P 2000, two RS 394, seven LV 1, five LD 2, two LG one LD 1 (information from circuit diagram).

TOTAL WEIGHT (including cables and antennas): 110 lbs.

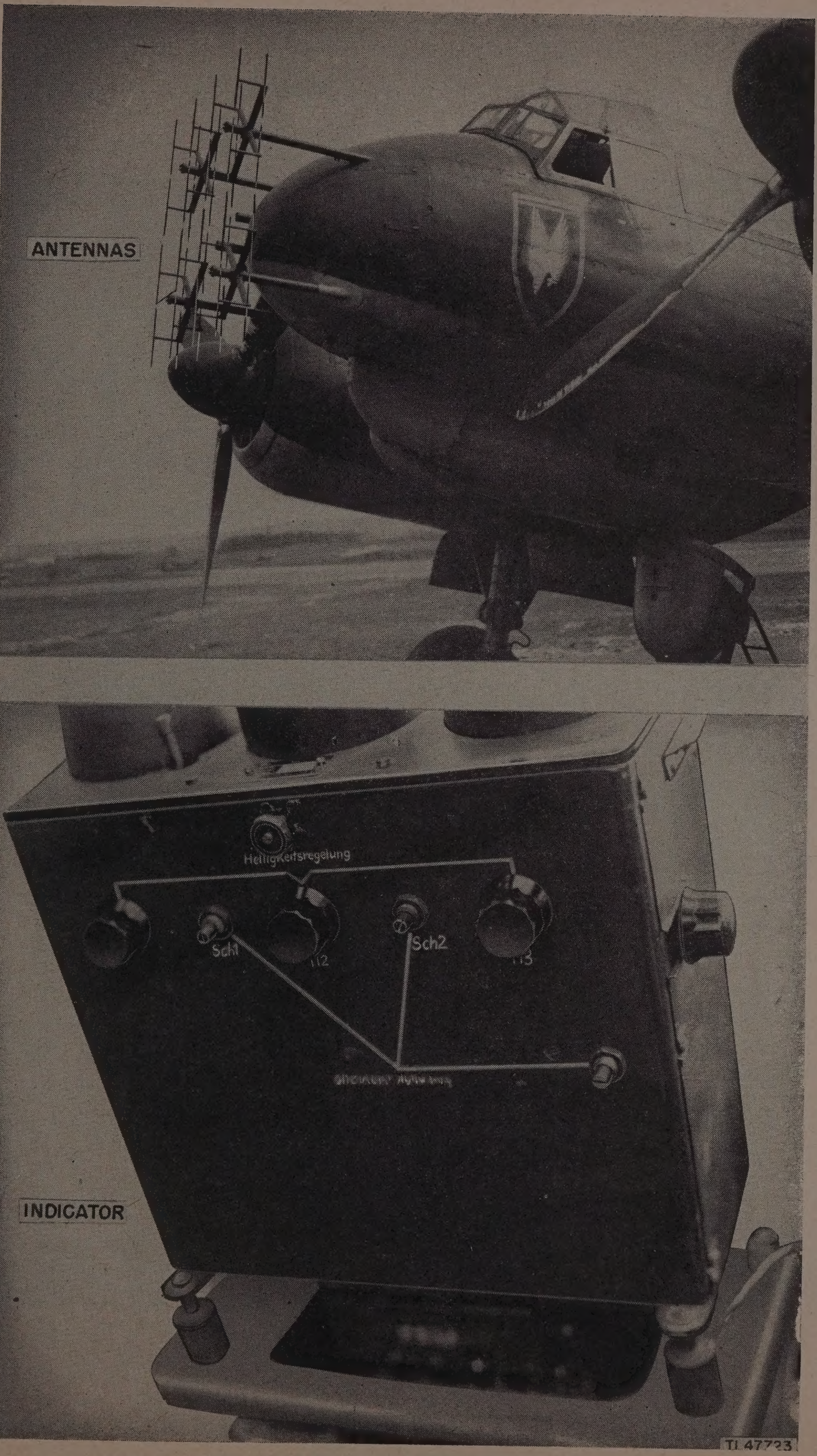

ANTENNAS
Helligkeitsregelung
Sch1
H2
Sch2
H3
INDICATOR
TL 47723

Figure 10. FuG 202 (Lichtenstein).

FuG 214 (LICHTENSTEIN R) AIRBORNE REAR AI RADAR

FuG 214, manufactured by Telefunken, is the first tail-warning apparatus introduced into the German Air Force and is used on multi-engined bombers.

This set is a greatly simplified version of an existing type (FuG 202) to meet the need for a backward-looking AI equipment. It utilizes many parts of the earlier type but uses only one CRT instead of the three fitted in FuG 202. It has no D/F facilities, no antenna matching gear; the receiver cannot be tuned in flight.

FuG 214 has been found in aircraft operating over Britain and the Mediterranean. Parts of it have been recovered from Ju 88 and Do 217. The advent of a later type, FuG 216, does not appear to have rendered FuG 214 obsolete. Latest evidence seems to show that both equipments are current.

The characteristics of the FuG 214 are as follows:

RANGE (miles): Theoretical, 5; practical, from 2 to 2½.

FREQUENCY RANGE (mc): 335 to 362.

PULSE RECURRENCE FREQUENCY (cps): 2,700.

PULSE LENGTH: 1 microsecond.

ANTENNA: Two identical Yagi arrays beamed to rear, made up of quarter-wave elements, under starboard wing for transmitting and under port wing for receiving. Beam width for half field strength is 35° to each side of line of flight, 55° down, and 20° up.

TYPE OF PRESENTATION: One CRT only.

POWER SOURCE: Motor generator U-10s and aircraft d-c supply.

SIMILAR SETS: FuG 202 and FuG 216.

TO REPLACE IN PART: FuG 202.

POWER INPUT REQUIRED: Not known.

POWER OUTPUT (watts): 450 (estimated peak).

PRINCIPAL COMPONENT

	DIMENSIONS			WEIGHT
	Height	*Width*	*Depth*	
New indicator	9½ in.	5½ in.	4¼ in.	
Total weight				110 lbs. (approx.)

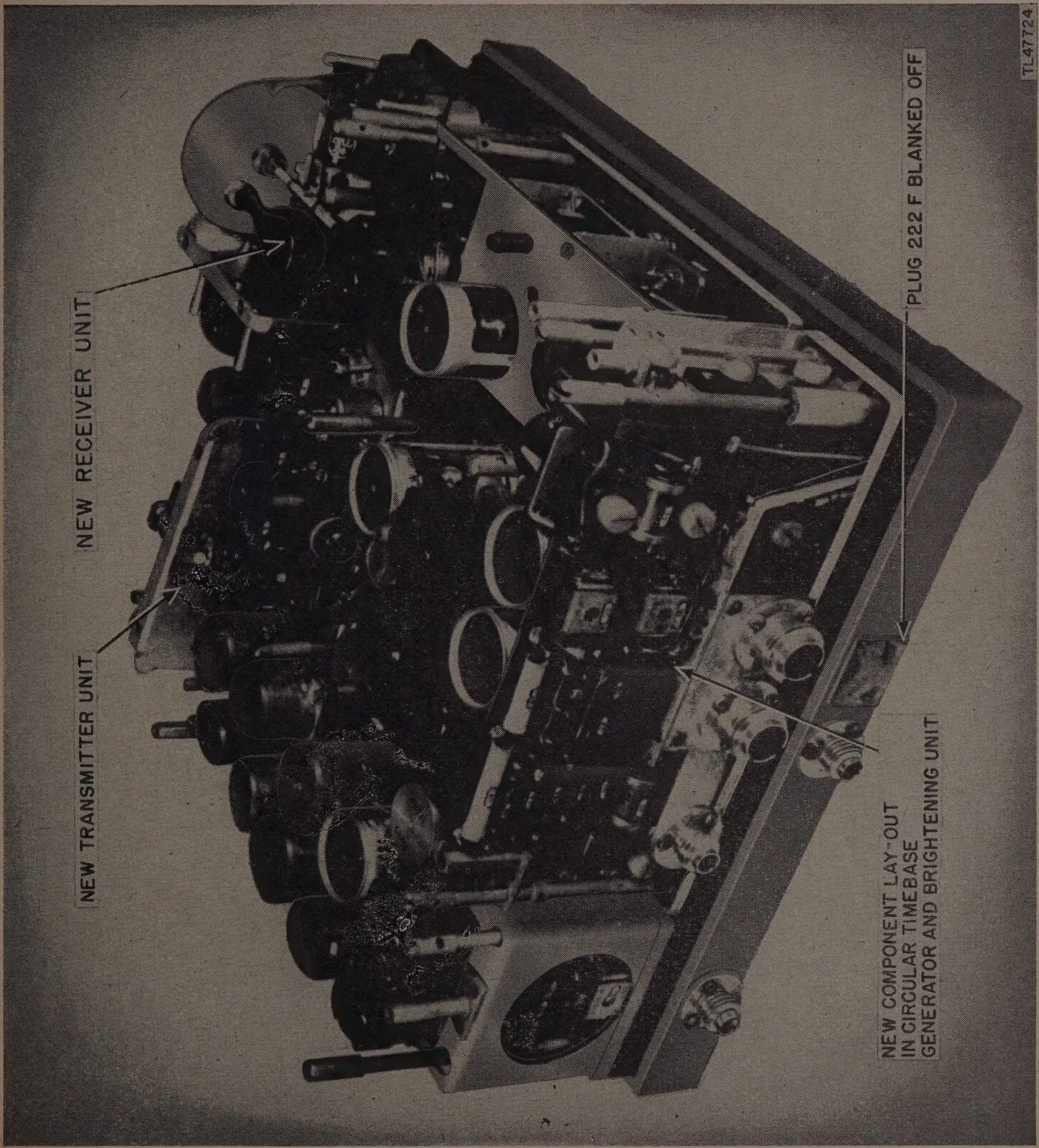

TL47724
NEW RECEIVER UNIT
NEW TRANSMITTER UNIT
PLUG 222 F BLANKED OFF
NEW COMPONENT LAY-OUT IN CIRCULAR TIMEBASE GENERATOR AND BRIGHTENING UNIT

Figure 11. FuG 214 (Lichtenstein R)—main block.

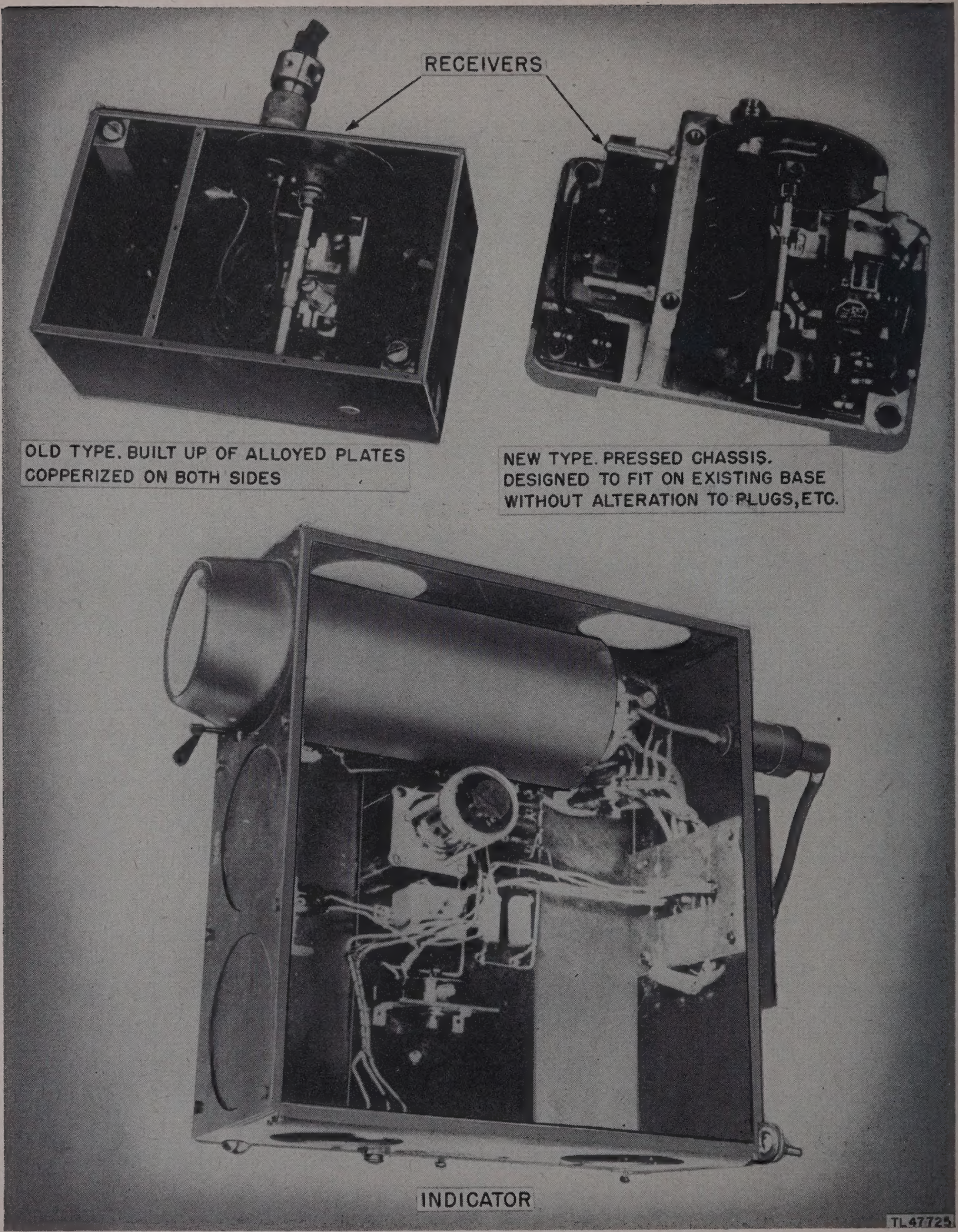

RECEIVERS
OLD TYPE. BUILT UP OF ALLOYED PLATES COPPERIZED ON BOTH SIDES
NEW TYPE. PRESSED CHASSIS. DESIGNED TO FIT ON EXISTING BASE WITHOUT ALTERATION TO PLUGS, ETC.
INDICATOR
TL47725

Figure 12. FuG 214 indicator unit showing new and old type receivers.

FuG 216 (NEPTUN GERÄT) AIRBORNE REAR AI RADAR

FuG 216 was designed as a backward-looking early-warning equipment; it is not a modification of an earlier type. This tail-warning device is used in multi-engined bombers in northwestern Europe and the Mediterranean; it has been recovered from Ju 88 and Ju 188. It operates satisfactorily at any height between 300 and 20,000 feet and gives clearer indications at high altitudes than any previous type. It can identify an Allied aircraft at long range by receiving its IFF reradiation.

The transmitting and receiving antennas, on starboard and port wings respectively, are 13 feet, 6 inches from wing tip and 23 feet from center of fuselage. The rear angle of search is 30° to port, starboard and above, but 60° downward. It has also a cone of search of about 30° to front made possible by the arrangement of reflector antennas. It has little flexibility, all controls except PRF on modulator unit being preset.

Mountings for the transmitter and power units, together with the relay and distribution box, are on a metal panel on the port side of the fuselage, aft of the bomb bay. Transmitter and modulator are in one very compact unit. The control circuit has one RV 12 P 2000 tube functioning as a squaring tube for the sine wave output of the RV 12 P 2000. From its plate to ground, there is a pulse transformer across the primary of which a diode, RG 12 D 60, is connected. The secondary is connected directly to the grids of six LD 2 tubes in parallel; it carries a biasing voltage stabilized by a stabilovolt.

The receiver, a 12-tube superheterodyne, hangs on a mounting frame fitted to the back of the operator's seat. It has four r-f stages, using RV 12 P 2000 tubes. The detector is an RC 12 D2, a double diode giving full-wave detection. All the tuned stages have variable tuning by means of trimmers.

The characteristics of the FuG 216 are as follows:

RANGE: (miles): 5 greater than that of FuG 214 or FuG 202.

FREQUENCY RANGE (mc): 150 to 182; spot, 166. Tuning range of receiver is about 200 mc, sensitivity 20 microvolts, bandwidth 1.5 mc.

PULSE RECURRENCE FREQUENCY (cps): 1,500 (variable).

PULSE LENGTH: Not known.

ANTENNA: Two identical quarter-wave Yagis beamed to rear; one under each wing. Antenna gain is estimated to be about 5 db. Beam width for half field strength is 60° to each side of line of flight, 60° down and 30° up.

TYPE OF PRESENTATION: A simplified presentation screen, semicircular, 3 inches in diameter, numbered and green in color; the number on which the pip appears represents the distance between the two planes. Presentation unit, beneath and slightly behind pilot's instrument panel, is easily visible to both pilot and observer and in this position provides maximum distance between transmitter and receiver.

POWER SOURCE: Motor generator U-10s and aircraft d-c power supply.

SIMILAR SETS: FuG 202, FuG 214.

TO REPLACE IN PART: FuG 214. Although FuG 214 is said to be obsolescent, it is believed that both FuG 214 and FuG 216 are still being used.

POWER INPUT REQUIRED: Not known.

POWER OUTPUT: Not known.

TUBES (type and number): Transmitter, not known. Receiver: twelve; five RV 12 P 2000, five LV 1, one RG 12 D2, and one of type not known (from circuit diagram).

PRINCIPAL COMPONENTS	DIMENSIONS			WEIGHT (lb.)
	Height (in.)	*Width (in.)*	*Depth (in.)*	
Transmitter	10	6¾	2	10
Receiver	9½	9	4¾	10
Indicator	7½	6½	4½	6 (approx.)
Junction box	8⅛	7⅛	3¾	
Indicator mounting frame	8	5¾	2	
Transmitter mounting frame	10½	7¼	1½	
Receiver mounting frame	9⅝	9⅛	1½	

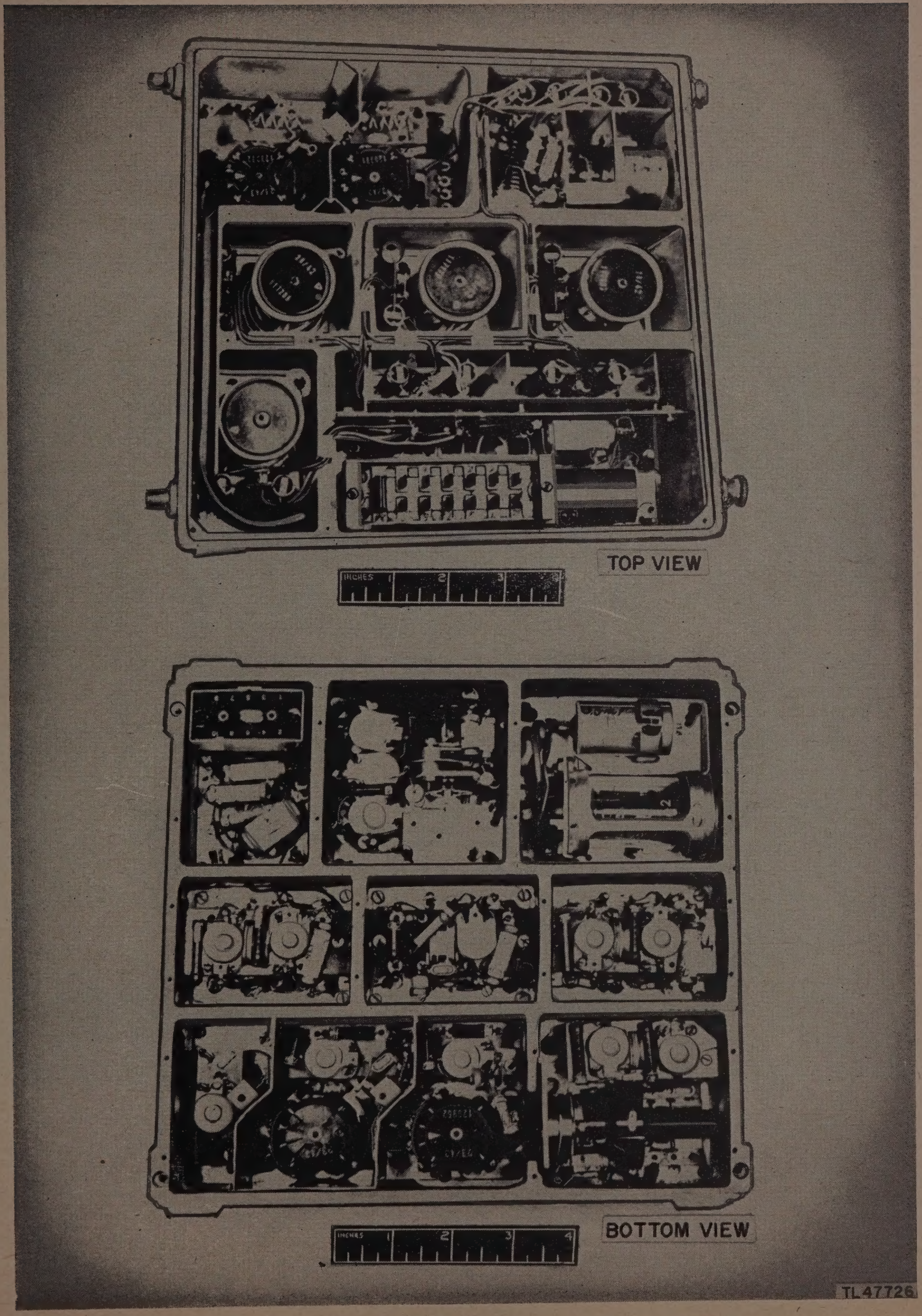

TOP VIEW
INCHES 1 2 3
BOTTOM VIEW
INCHES 1 2 3 4
TL 47726

Figure 13. Receiver (E 216) FuG 216 (Neptun Gerät).

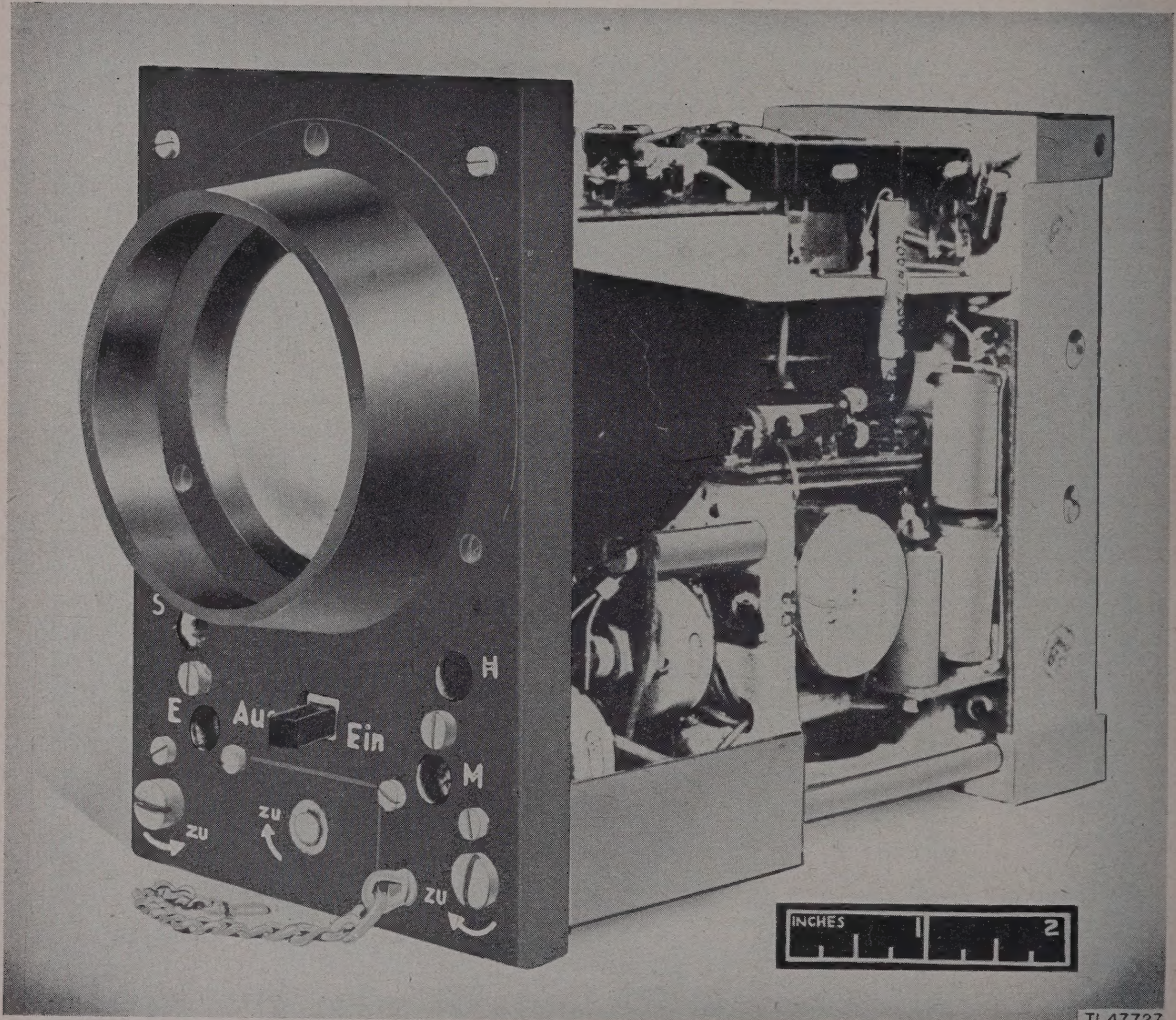

S
H
E
Aus
Ein
M
ZU
ZU
ZU
INCHES 1 2
TL47727

Figure 14. FuG 216 Indicator (SG216).

GROUND RADAR

German ground radar sets can be classified into four main categories:

(1) German Air Force early-warning sets operating at 120 to 130 mc (nominal wavelength 2½ meters) including: Freyas (Pole and Limber types), general purpose, transportable sets; and Hoardings (Mammut) and Chimneys (Wassermann), fixed-station, long-range warning sets.

(2) Würzburgs, sets designed for Flak control and operating on 550–590 mc (nominal wavelength 53 cm). As successive improvements have been made on this set, previous models have been released for height-finding with the Aircraft Reporting Service, etc. The Lorenz set is a nonstandard variant of the Würzburg, believed to have been relegated to coast-watching duties with the German Navy.

(3) Giant Würzburgs, sets primarily used for interception control and also now used for general purposes, including sea watching and Flak control.

(4) Coastwatchers (Seetakt), German Navy sea-watching sets operating on 370 to 390 mc (nominal wavelength 80 cm); these are naval sets on the same mountings as Freyas.

Some of these frequency bands have been modified. Freyas, for example, are known to operate between 90 to 190 mc, and the Würzburgs between 500 and 600 mc.

Note. Measurements on the following illustrations are shown in meters. 1 meter = 3.28 feet.

FREYA (LIMBER TYPE) EW RADAR

The Freyas (Pole type and Limber type) are heavy, general purpose, transportable ground radar sets, differing primarily in their mounting. Manufactured by Gema, the equipment is used to provide early warning of approaching aircraft in the form of range and azimuth at ranges up to 100 miles and also to detect shipping up to small ranges. Azimuth of a target is determined by rotation of the operating cabin and the antenna structure.

The standard Freya has no height-finding facilities, although rough estimates of height based on pick-up range are possible with later modifications. The inability of the Freya to measure height is made good by the use of one or more Würzburgs sited in the same vicinity. In conjunction with one or two Giant Würzburgs, the Freya, with AN attachment, may be used for ground control of night fighter interception. Day fighters are frequently controlled on Freya plots.

Since performance figures vary with the elevation of the site and the altitude of the aircraft (in addition to atmospheric effects), being better at high elevations, high siting is probably the normal policy for early-warning radars. Freyas are usually sited at elevations of at least 200 feet.

The so-called "Limber type" Freya is an early model and is distinguished by an operating cabin on a modified 88-mm Flak (antiaircraft) gun mounting, provided with two detachable two-wheel "limbers" for road transport. The rotating cabin contains the radar equipment and supports the superstructure which carries the separate transmitting and receiving antenna arrays; each array is 20 feet wide and 8 feet high and carries six full-wave vertical dipoles. When IFF facilities are required, a third and smaller array is mounted above the receiving antenna. The transmitter, transmitter modulator, and filament supply units are mounted in a cabinet carried within the thickness of the transmitting antenna frame. The transmitter cooling fan is mounted nearby.

The heart of the Freya, according to some German reports, is the master oscillator or "Summer." This is a very stable triode-connected pentode audio oscillator. It has several output sections, one of which feeds through a phase-shifter to the transmitter modulator, which provides the 2-microsecond pulse modulation for the grids of the transmitter tubes.

The Freya receiver, which is similar to that used in the Coastwatcher radar, has a frequency coverage of 120 to 128 mc with one signal frequency stage, two 15-mc i-f stages, two 7-mc i-f stages, detector, and video amplifier. It is built in two units, the three-stage r-f section with its stabilized power supply being independent of the i-f amplifier to which it is attached.

The 125-mc input from the receiving antenna is inductively coupled to a tuned circuit in the grid of the r-f amplifier tube, and the output from the tuned circuit in its anode is mixed with the 110-mc output from the local oscillator on the grid of the output tube. The 15-mc beat frequency is fed to the output socket from the tuned circuit in the anode of the output tube.

An interesting feature of the r-f unit is the special ceramic holders and mountings for the input and output tubes, which slide into position and engage with the circuit and supply terminals. The ceramic plate which fits into the grooves is sprayed on one side with copper and assures complete screening of the compartment. Decoupling capacitors for the tubes are built in the ceramic holders.

The rectified output of the receiver is fed to two presentation units. These consist of a general search unit (main presentation unit NB) with fast and slow timebase CRT's and a single tube unit with fast nonlinear timebase for precision ranging (fine range presentation unit

OB). All the cathode-ray tubes are of the double-beam type, the second trace being used for display of the IFF signals. This equipment was introduced into service in 1939.

The characteristics of the Limber type Freya are as follows:

RANGE (miles): From 80 to 150, depending upon height of aircraft.

FREQUENCY RANGE (mc): Normally 120 to 150 mc. Band now extended from 90 to 190 mc, signals being heard from 90 to 110 mc and from 175 to 190 mc. IFF receiver frequency, about 155 mc.

PULSE RECURRENCE FREQUENCY (cps): 500; 1,000 (older models).

PULSE LENGTH: 2 to 3 microseconds.

ANTENNA: Vertical stack of two rectangular frames of wire netting each having six full-wave vertical dipoles, the bottom frame for transmitting and the upper for receiving. A third array with half-wave dipoles is mounted at the top if the set is not in the IFF band. Effective beam width of transmitting and receiving array: about 20°.

TYPE OF PRESENTATION: Two units having 10-cm double-beam CRT's (AEG Type HR2/100/1.5A) with straight traces viewed through magnifying lenses. Main unit has two tubes with slow and fast timebases for general observation and approximate range. Second unit has one high-speed trace for precision ranging.

DATA OBTAINED: Range and azimuth (plus altitude with some models).

ACCURACY: Good. Reported to be probably 110 yards in range, better than 1° in azimuth, 0.2° in relative azimuth.

POWER SOURCE: Power lines or stand-by 380-volt three-phase a-c motor-generator trailer. Radar equipment operates on 220 volts single-phase ac; 400 volts dc required for motor and field windings.

SIMILAR SETS: There are several known types of Freya: the original Limber type (FMG 39G and FMG 40G, also known as Dete-Gerät I (DT I) and Dete-Gerät II (DT II), respectively); the demountable Pole type (LZ, known also as Pole Freya); the Freya AN (Freya with AN unit for GCI); and the Coastwatcher (Seetakt) which is a naval installation.

POWER OUTPUT: 15 to 20 kw (peak).

TUBES (type and number): Transmitter (T 106): two RS 391 pentodes, two TS 41 triodes, and one STV 280/40. Receiver (NE 103): r-f unit (NA 100) uses two acorn pentodes Philips type 4672 for amplifier and mixer, triode RL 12 T 1 as local oscillator; i-f unit (NZ 102) uses eight pentodes AF 100 and power pentode RL 12 P 10 for video amplifier.

TOTAL WEIGHT OF FREYA: 6.82 tons.

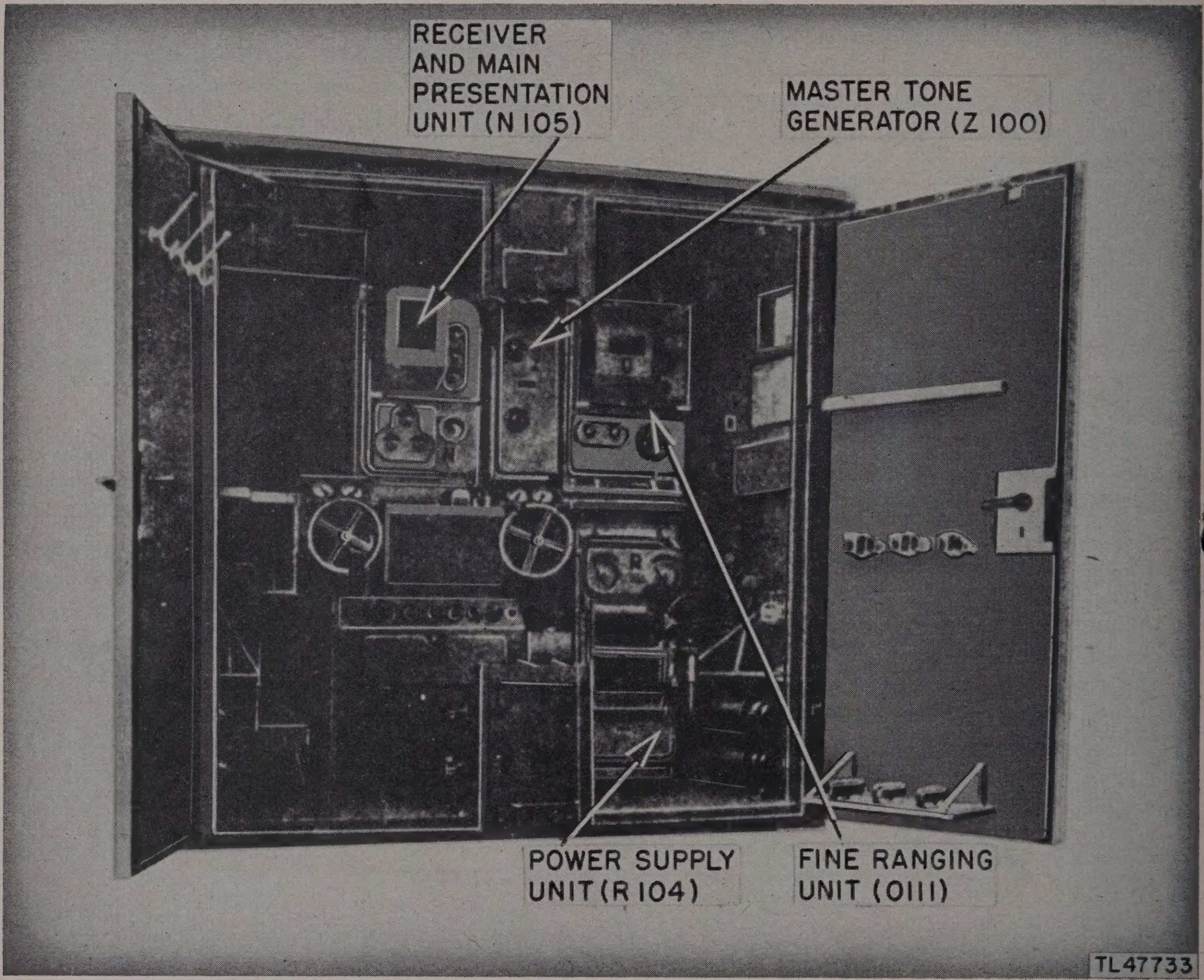
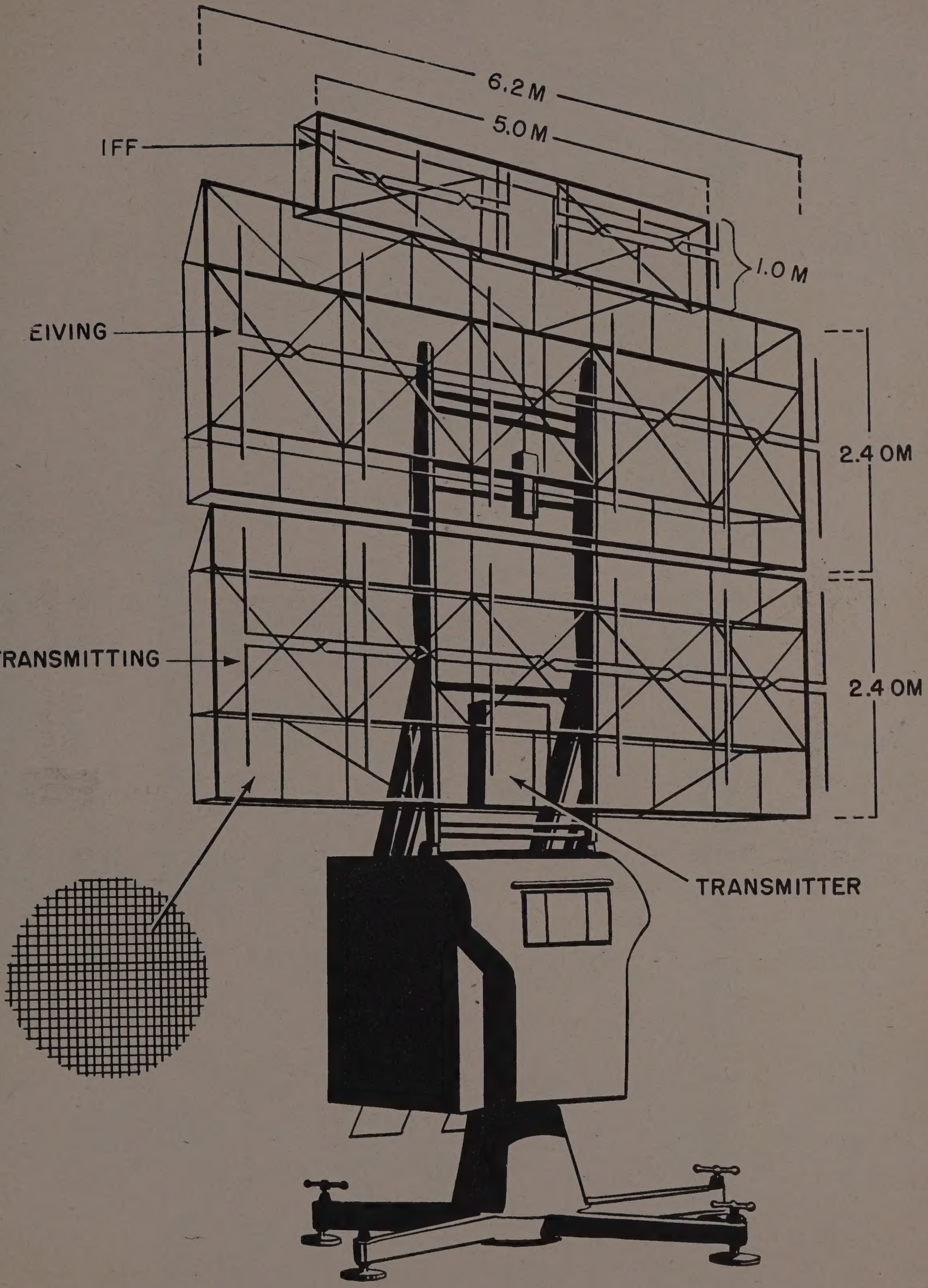

RECEIVER AND MAIN PRESENTATION UNIT (N 105)
MASTER TONE GENERATOR (Z 100)
POWER SUPPLY UNIT (R 104)
FINE RANGING UNIT (O111)
TL47733

Figure 15. Interior of Freya (Limber) cabin.


6.2 M
5.0 M
IFF
1.0 M
EIVING
2.4 OM
TRANSMITTING
2.4 OM
TRANSMITTER

TL47739

Figure 16. Limber Freya.

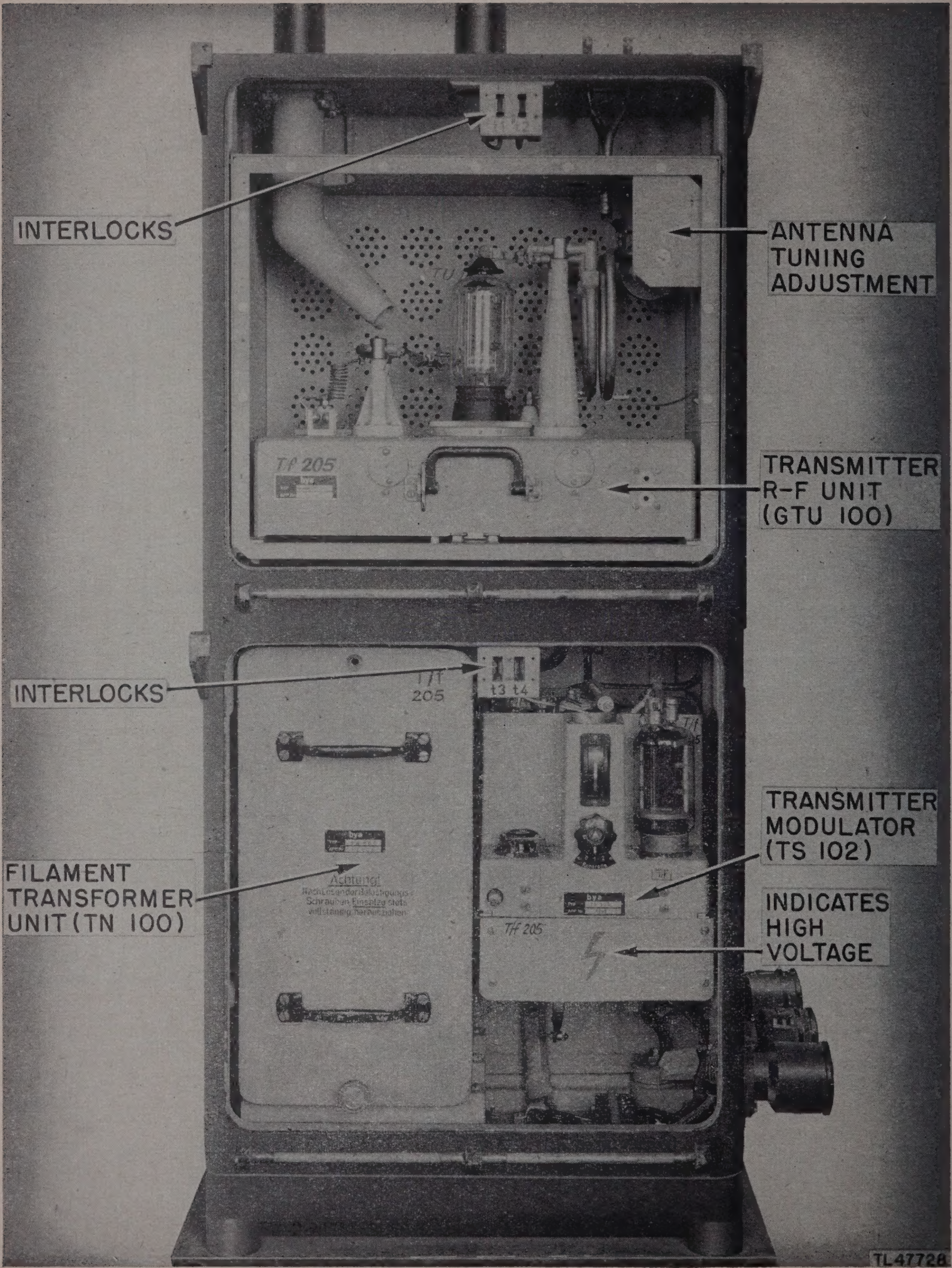
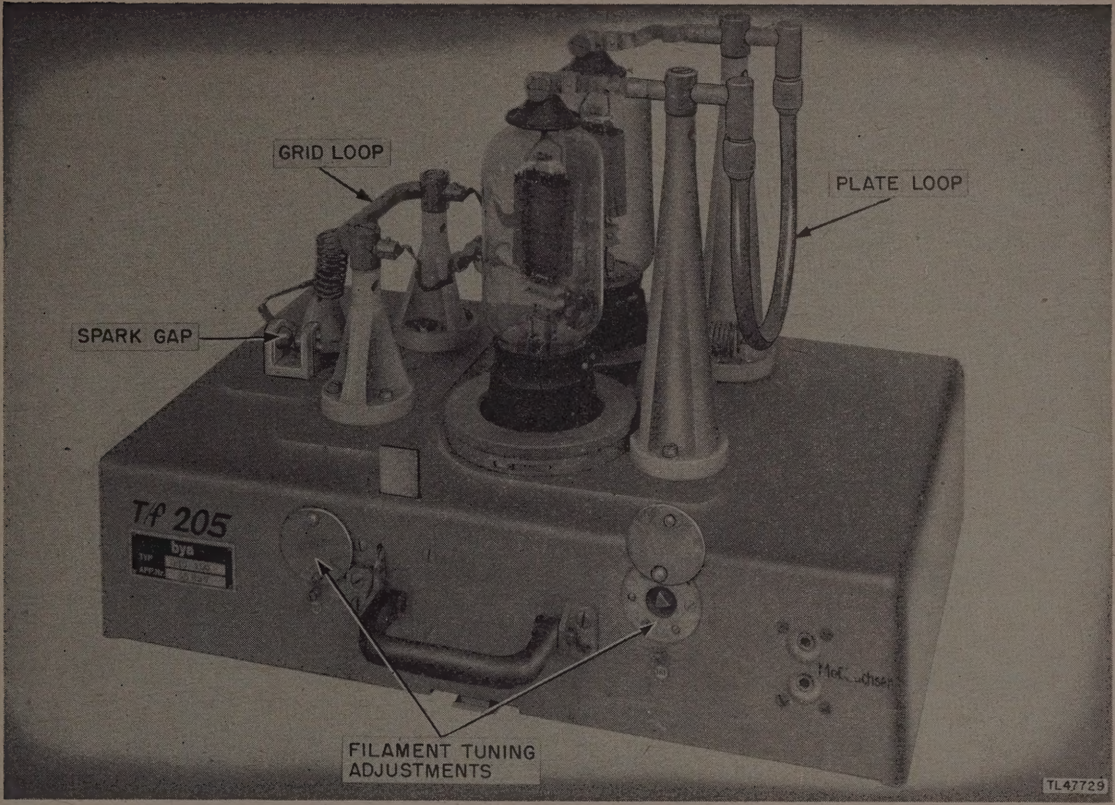
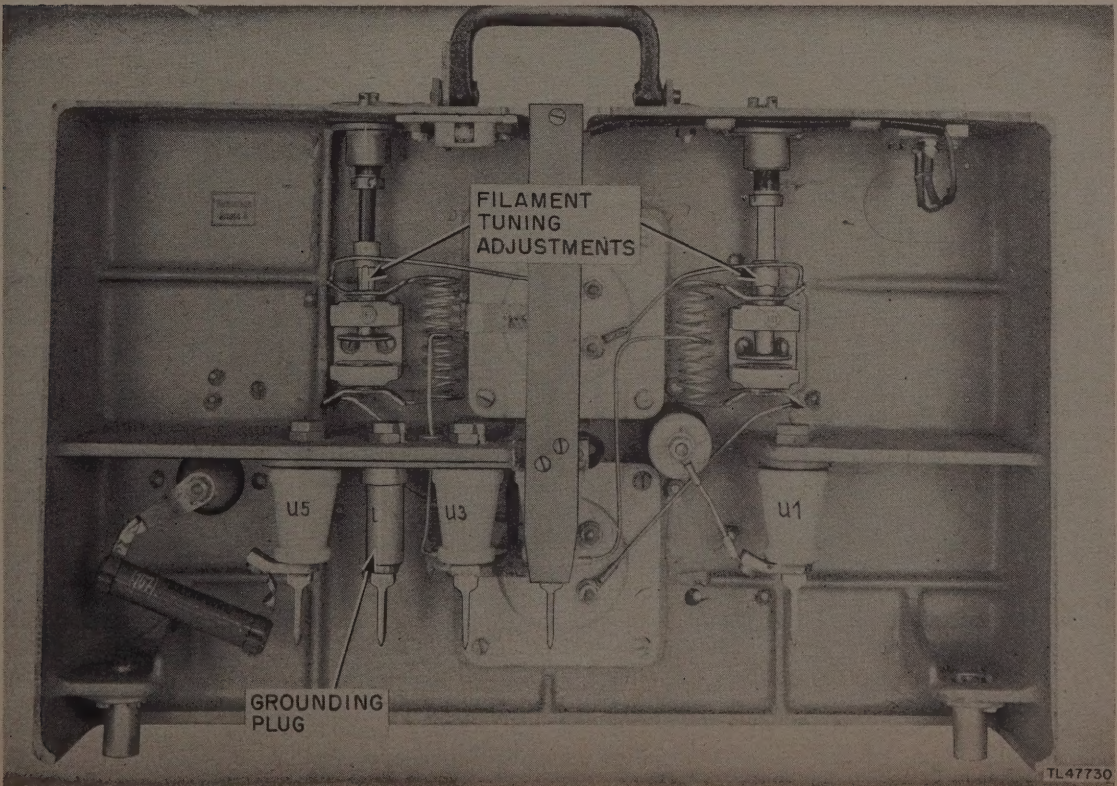

INTERLOCKS
ANTENNA TUNING ADJUSTMENT
TRANSMITTER R-F UNIT (GTU 100)
Tf 205
INTERLOCKS
t3 t4
Tf 205
TRANSMITTER MODULATOR (TS 102)
FILAMENT TRANSFORMER UNIT (TN 100)
Achtung!
INDICATES HIGH VOLTAGE
Tf 205
TL47728

Figure 17. Freya transmitter (T 106).


GRID LOOP
PLATE LOOP
SPARK GAP
Tf 205
FILAMENT TUNING ADJUSTMENTS
TL47729

① *Top view.*


FILAMENT TUNING ADJUSTMENTS
U5
U3
U1
GROUNDING PLUG
TL47730

② *Bottom view.*
Figure 18. Freya transmitter r-f unit (GTU 100).

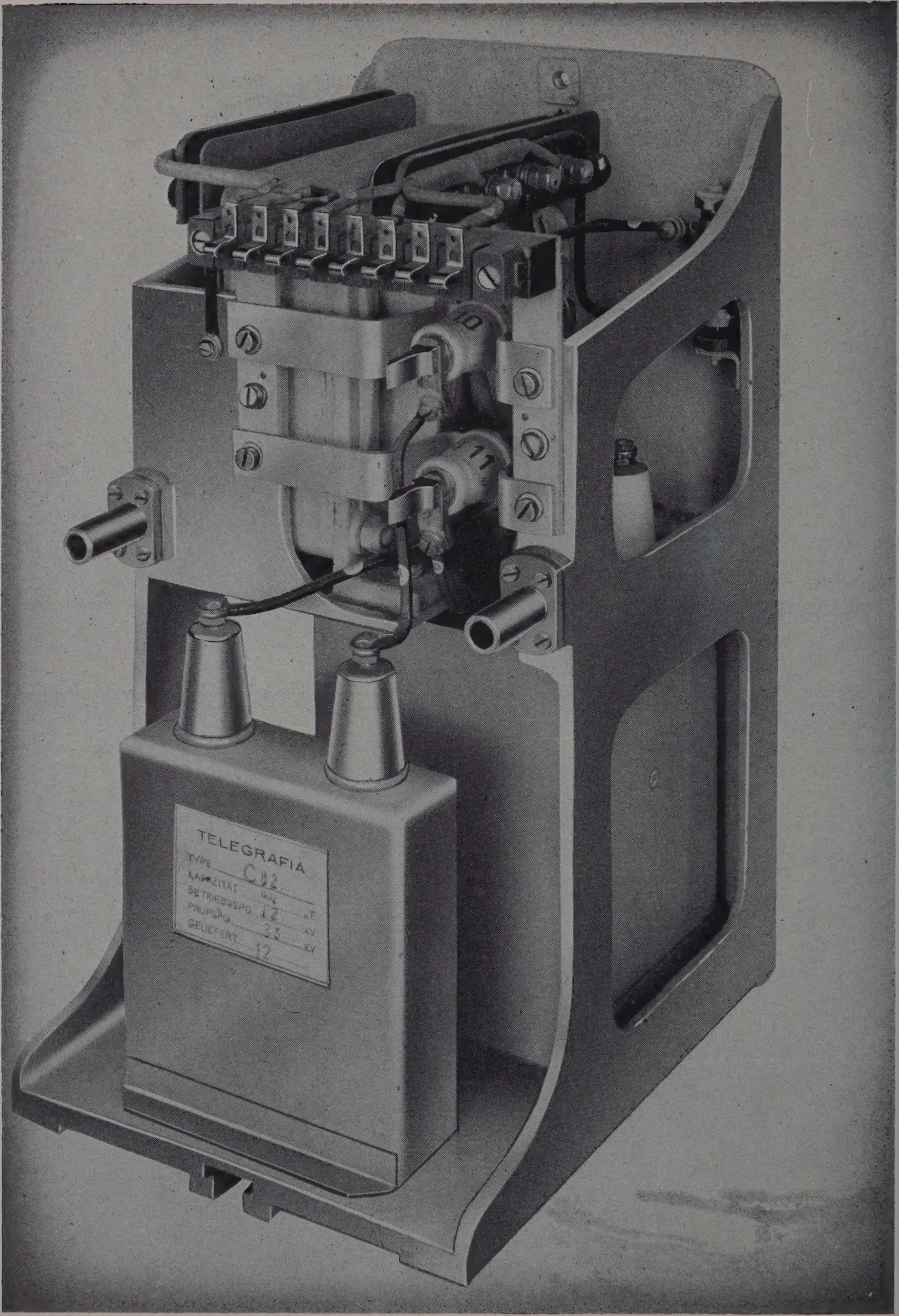

10
11
TELEGRAFIA
TYPE C82
KAPAZITÄT
BETRIEBSSPG 12 μF
PRÜFSPG 35 kV
GELIEFERT 12 kV

Figure 19. Freya transmitter filament transformer unit (TN 100)—rear view.

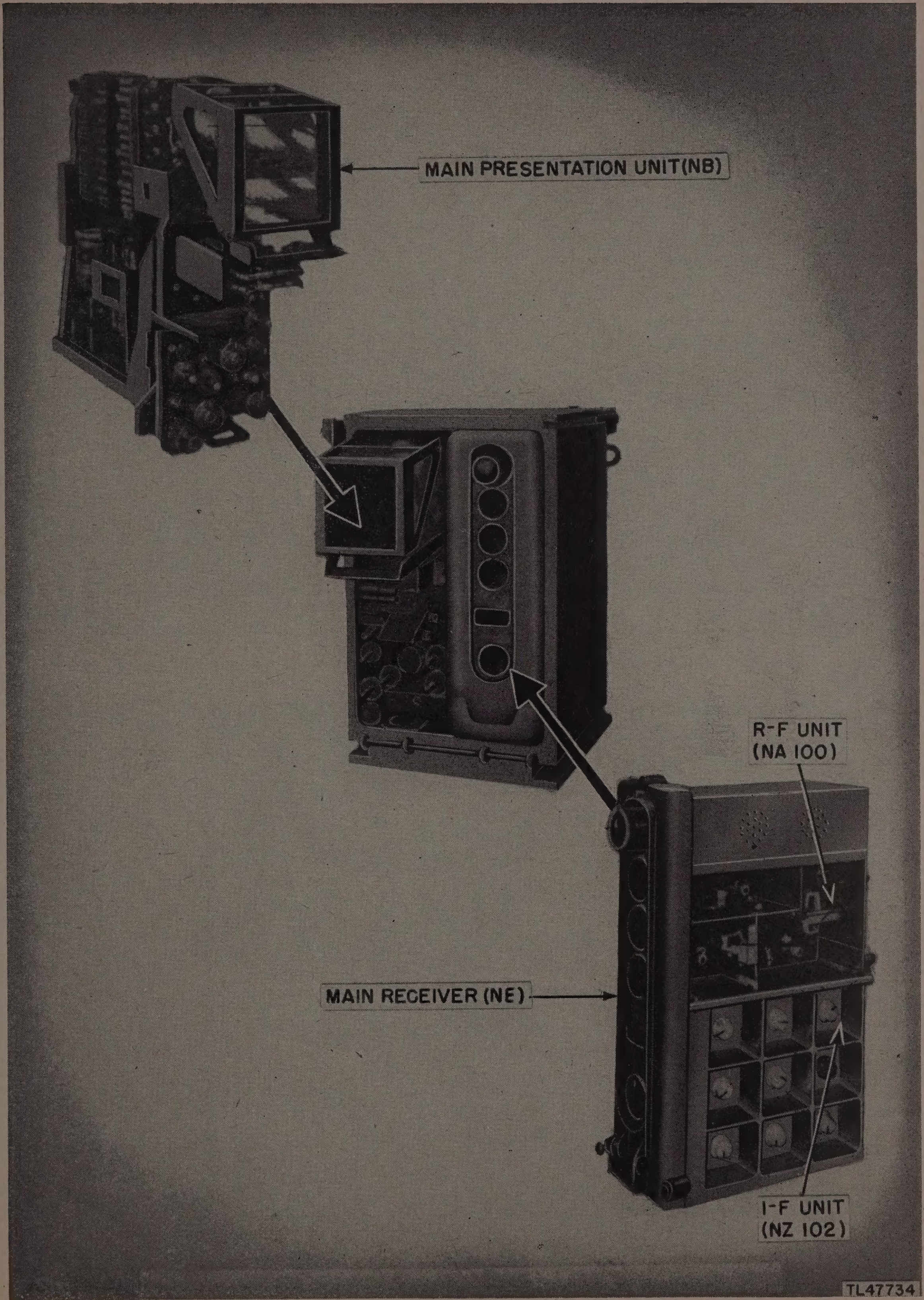

MAIN PRESENTATION UNIT(NB)
R-F UNIT
(NA 100)
MAIN RECEIVER (NE)
I-F UNIT
(NZ 102)
TL47734

Figure 20. Freya main receiver and presentation unit (N 105).

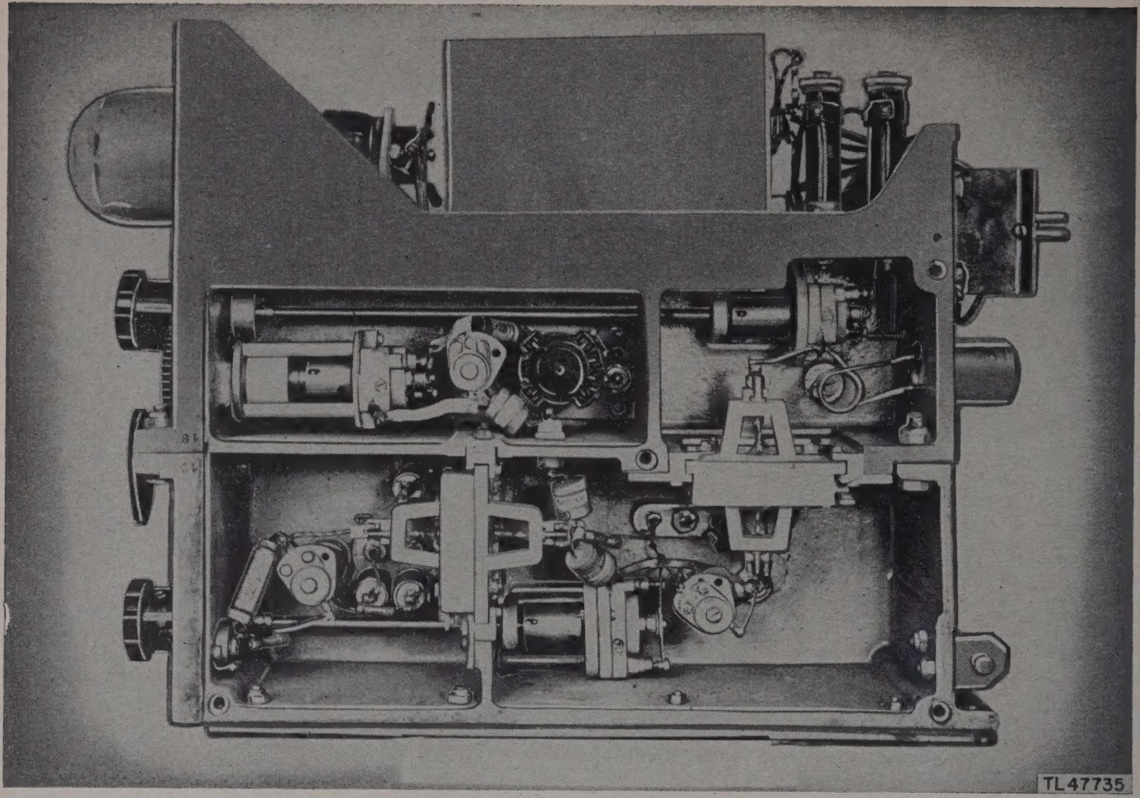


Figure 21. Freya receiver r-f unit (NA 100).

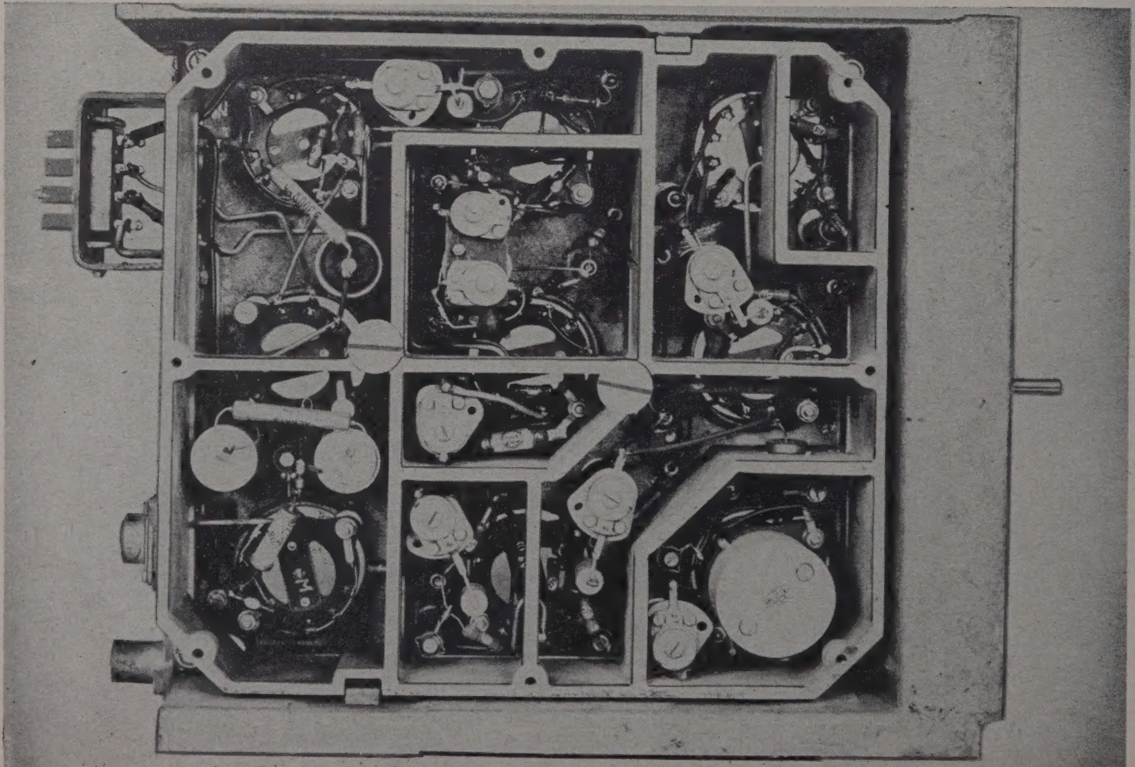


Figure 22. Freya receiver i-f unit (type NZ 102).

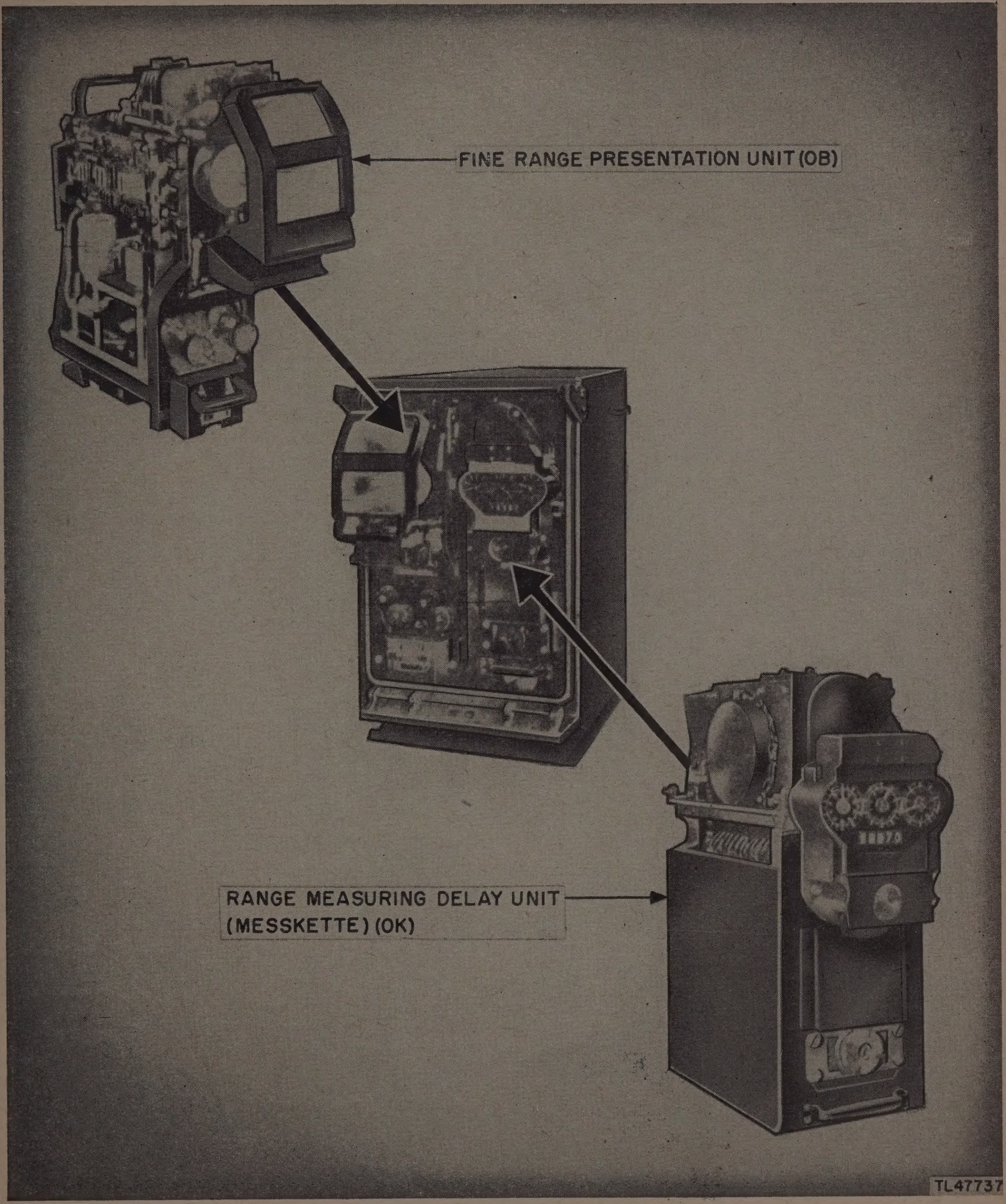

FINE RANGE PRESENTATION UNIT (OB)
RANGE MEASURING DELAY UNIT (MESSKETTE) (OK)
TL47737

Figure 23. Freya fine ranging and presentation unit (0 111).

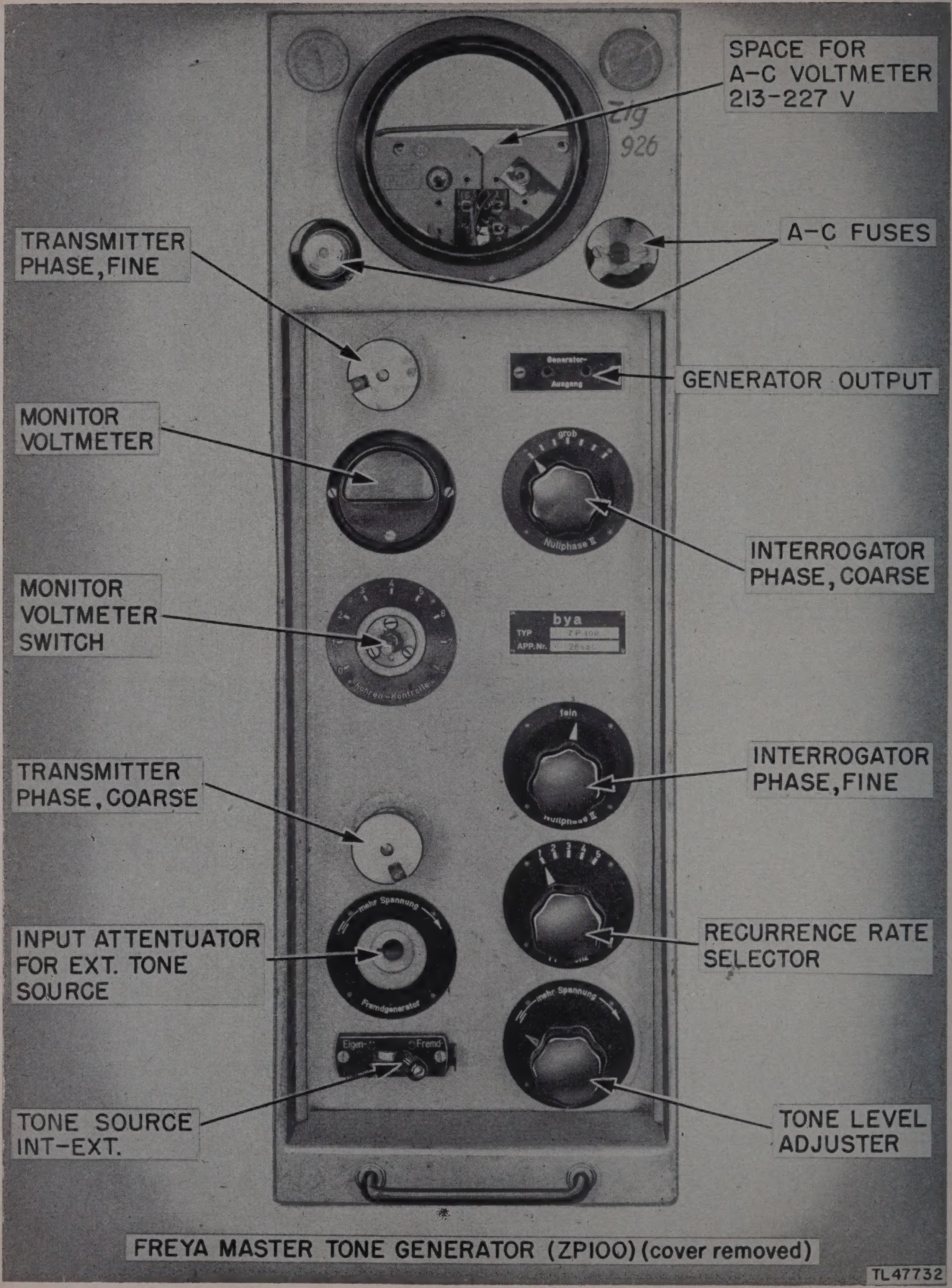

SPACE FOR
A-C VOLTMETER
213-227 V
Zlg
926
A-C FUSES
TRANSMITTER
PHASE, FINE
Generator-
Ausgang
GENERATOR OUTPUT
MONITOR
VOLTMETER
grob
Nullphase II
INTERROGATOR
PHASE, COARSE
MONITOR
VOLTMETER
SWITCH
Röhren-Kontrolle
bya
TYP ZP 100
APP.Nr.
fein
INTERROGATOR
PHASE, FINE
TRANSMITTER
PHASE, COARSE
mehr Spannung
RECURRENCE RATE
SELECTOR
INPUT ATTENTUATOR
FOR EXT. TONE
SOURCE
Fremdgenerator
Eigen-
Fremd-
TONE SOURCE
INT-EXT.
TONE LEVEL
ADJUSTER
FREYA MASTER TONE GENERATOR (ZP100) (cover removed)
TL47732

Figure 24. Freya master tone generator (ZP 100)—cover removed.

FREYA (POLE TYPE) EW RADAR

The Pole type Freya is a newer design than the Limber type. Its functions, performance, and radio characteristics are much the same, but its form and mechanical design are entirely new. The most obvious difference is in its mechanical mounting; it is assembled from a larger number of smaller components to render it suitable for air transport (it is known that five Ju 52's are required to transport a complete station). It is not fitted with limbers for use as a mobile set, but may be transported in three big trucks.

This Freya usually has IFF antennas and gives azimuth readings that are accurate to a fraction of a degree. Beam width of the transmitter is 40° and of the receiver, 48°, from zero to zero. IFF receiver frequency is 155 plus or minus 5 mc (approximately). IFF interrogator frequency (when Freya frequency differs from 125 mc) is 125 mc, 500 pulses per second, with peak power approximately 0.5 to 1.0 kw. The IFF presentation consists of parallel traces on tubes in presentation units.

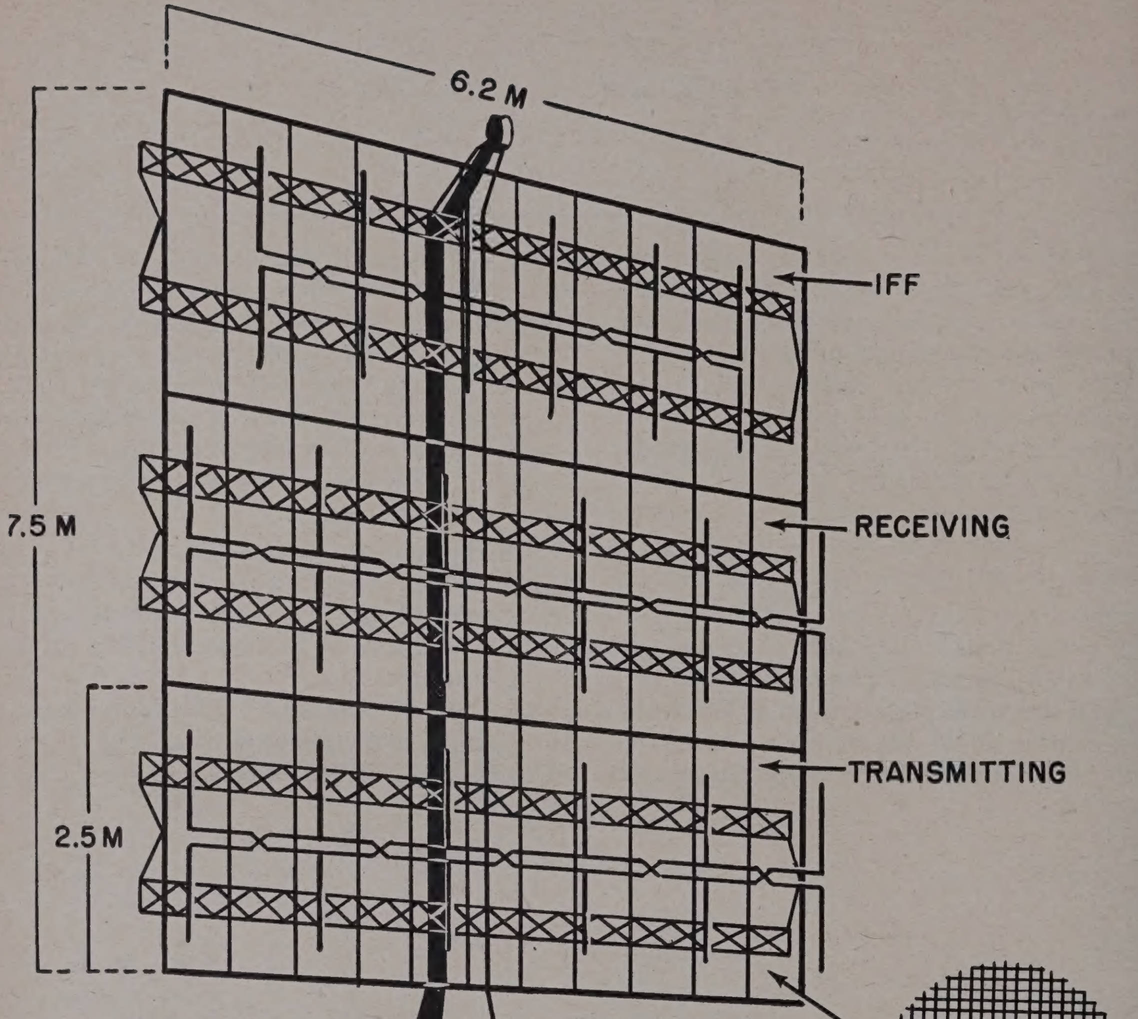
Characteristics of the Pole type Freya are similar to those for the Limber type, with the following differences:

RANGE (miles): About 120.

ANTENNA: Antennas mounted on heavy pole instead of the framework used with the Limber type. IFF array consists of full-wave dipoles.

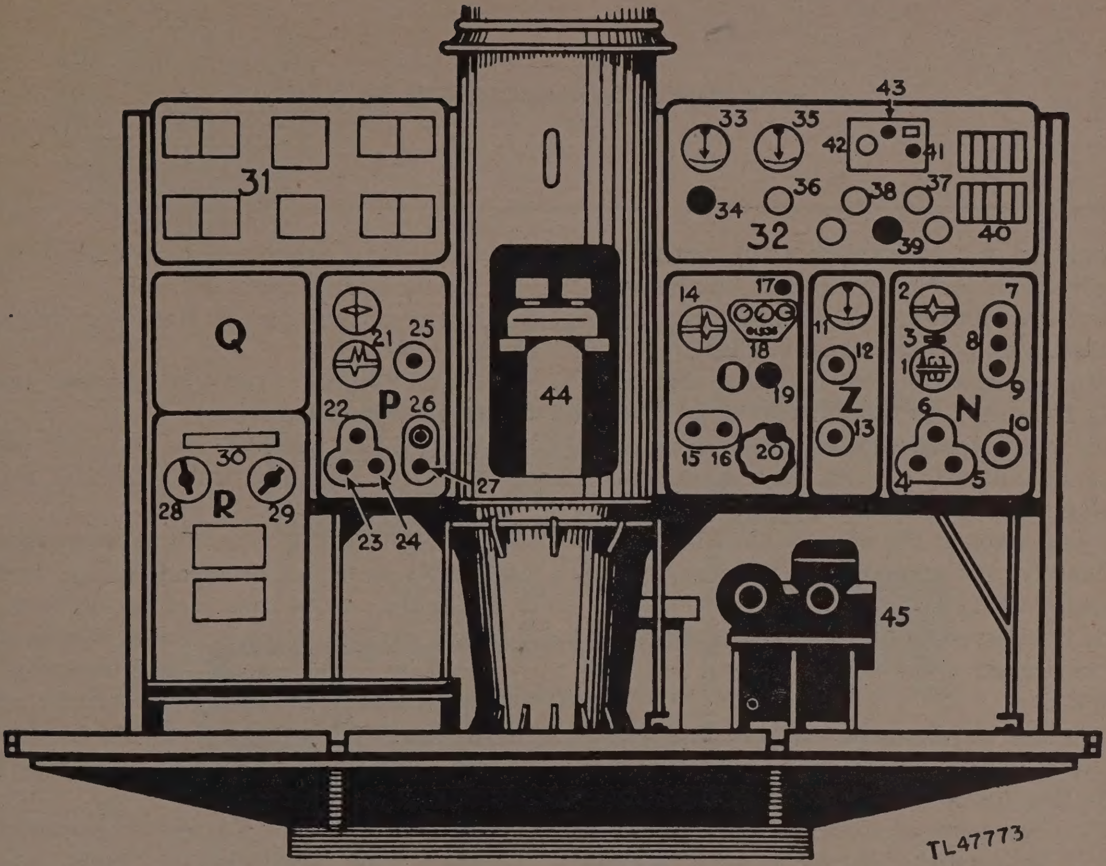
TYPE OF PRESENTATION: Three units all with 10-cm double-beam CRT's.

TOTAL WEIGHT: 5 tons.


6.2 M
IFF
RECEIVING
7.5 M
TRANSMITTING
2.5 M

TL47740

Figure 25. Pole Freya.



1 Main presentation tube.
2 Fast (Strobe) tube.
3 Rough range indicator.
4 Focus.
5 Brilliance.
6 Strobe position.
7 Receiver tuning r-f.
8 Receiver tuning local oscillator.
9 Receiver tuning mixer.
10 Receiver gain control.
11 Precision mains voltmeter.
12 Transmitter phase control—fine.
13 Transmitter phase control—coarse.
14 Fine range presentation tube.
15 Focus.
16 Brilliance.
17 Zero-setting key.
18 Fine range indicating dials and window.
19 Coarse range adjustment.
20 Fine range adjustment.
21 Presentation tubes.
22 Strobe control.
23 Focus.
24 Brilliance.
25 Changeover, "recognition—location."
26 IFF receiver gain (inner) recognition—location (outer).
27 IFF receiver tuning.
28 HT on/off switch.
29 Transmitter HT regulator.
30 Instrument panel:
  Supply volts.
  T. anode current.
  T. bias volts.
  T. anode volts.
  Receiver H-T volts.
  T or Q radiation meter.
31 Switch panel II (heaters and fans).
32 Switch panel I.
33 A.C. voltmeter 213–227 Volts.
34 Fine voltage adjuster.
35 Supply voltmeter 0–260 Volts.
36 Voltmeter switch.
37 Main on/off switch.
38 Cut-out for door contact.
39 Voltage regulator.
40 Cabin lighting and heating switches.
41 Frequency meter tuning.
42 Frequency meter indicator.
43 Frequency meter sensitivity.
44 Slip rings.
45 Turning gear.
N Main presentation unit.
Z Master tone generator.
O Fine range unit.
P Presentation unit.
Q IFF interrogator.
R Power supply.
T (Not shown) Transmitter unit, placed behind pole.

Figure 26. Controls of Pole type Freya.

HOARDING (MAMMUT) EW RADAR

Employed for long-range early-warning of enemy aircraft on coastal areas in northwestern Europe, the Hoarding or Mammut radar was manufactured by Gema (1942). This equipment is contained in a concrete building, completely or partly buried, surmounted by four upright girders with cross girders carrying the antenna arrays. Scanning is electrical by phase control, covering a sector about 120° wide, front or back, with gaps at the side. Beam width is approximately 10° from zero to zero. It is equipped with IFF.

This is believed to be an experimental model used in limited areas and never put into production.

A similar equipment, known as "Small Hoarding," makes use of three concrete buildings in line for foundations, with the two outside chambers somewhat larger than the middle one. It is believed that it may be used for coast watching, since the sites where it has been noted are closely associated with coast-watching duties. Three vertical girders spring from the buildings and carry crossmembers supporting the reflector frames. At the top of the uprights there is a curved horizontal rail that is probably used for a running block and tackle to hoist the antenna arrays into position.

Characteristics of the Hoarding are as follows:

RANGE (miles): 180 (20,000-foot target); 125 (3,000-foot target).

FREQUENCY RANGE (mc): 116 to 146.

PULSE RECURRENCE FREQUENCY (cps): Believed to be 490 to 510.

PULSE LENGTH: 2 to 3.5 microseconds.

ANTENNA: Fixed broadside array, vertically polarized, about 100 feet by 36 feet. Full-wave vertical dipoles. Array can be single-faced or both forward- and backward-looking. Possibly common T&R. Arrays are like Freya except larger.

TYPE OF PRESENTATION: Similar to Freya.

DATA OBTAINED: Range and azimuth.

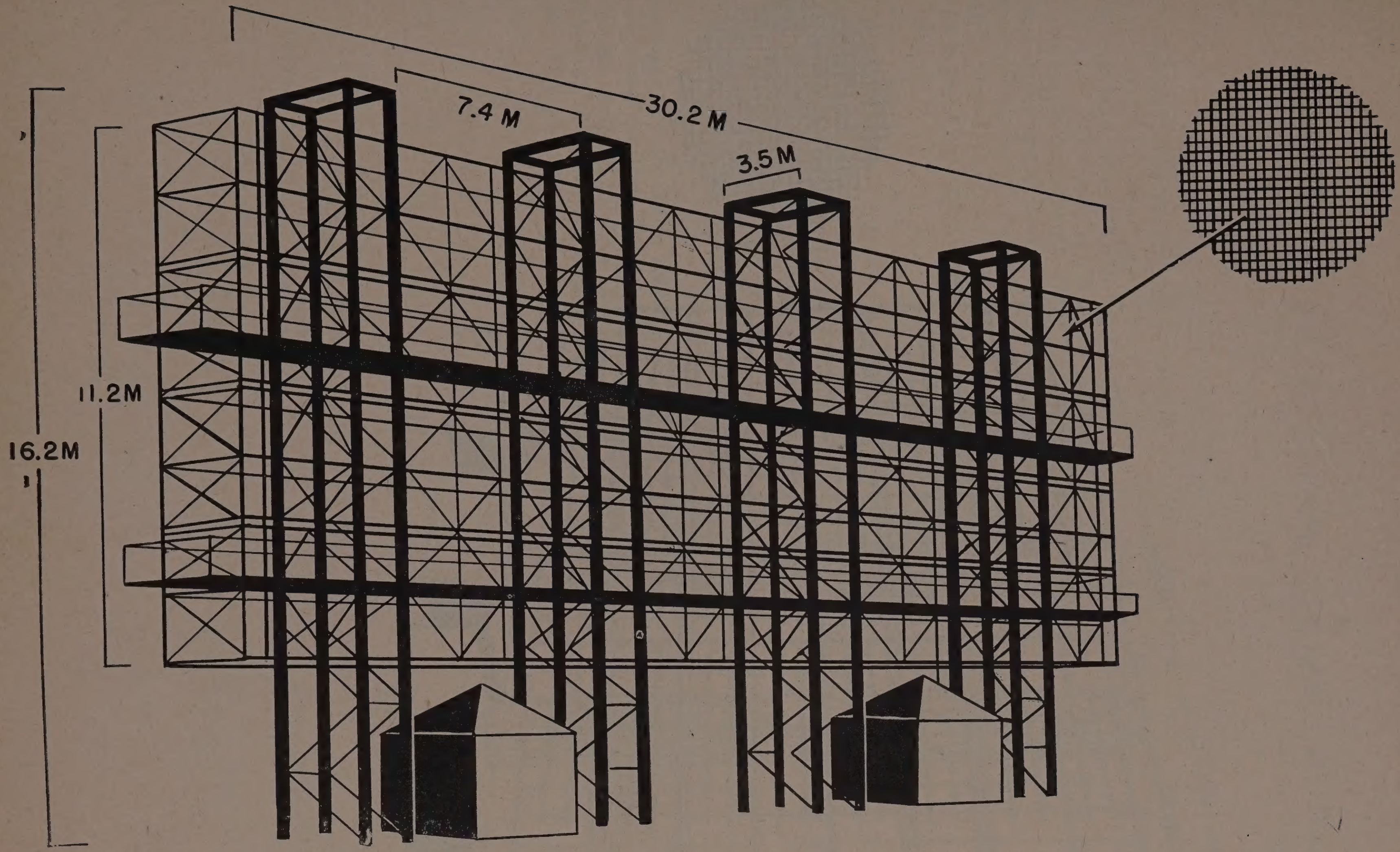
POWER SOURCE: Power lines; stand-by motor generator sets.

SIMILAR SETS: Freya; Chimney (Wassermann).

POWER OUTPUT: 20 kw (peak).

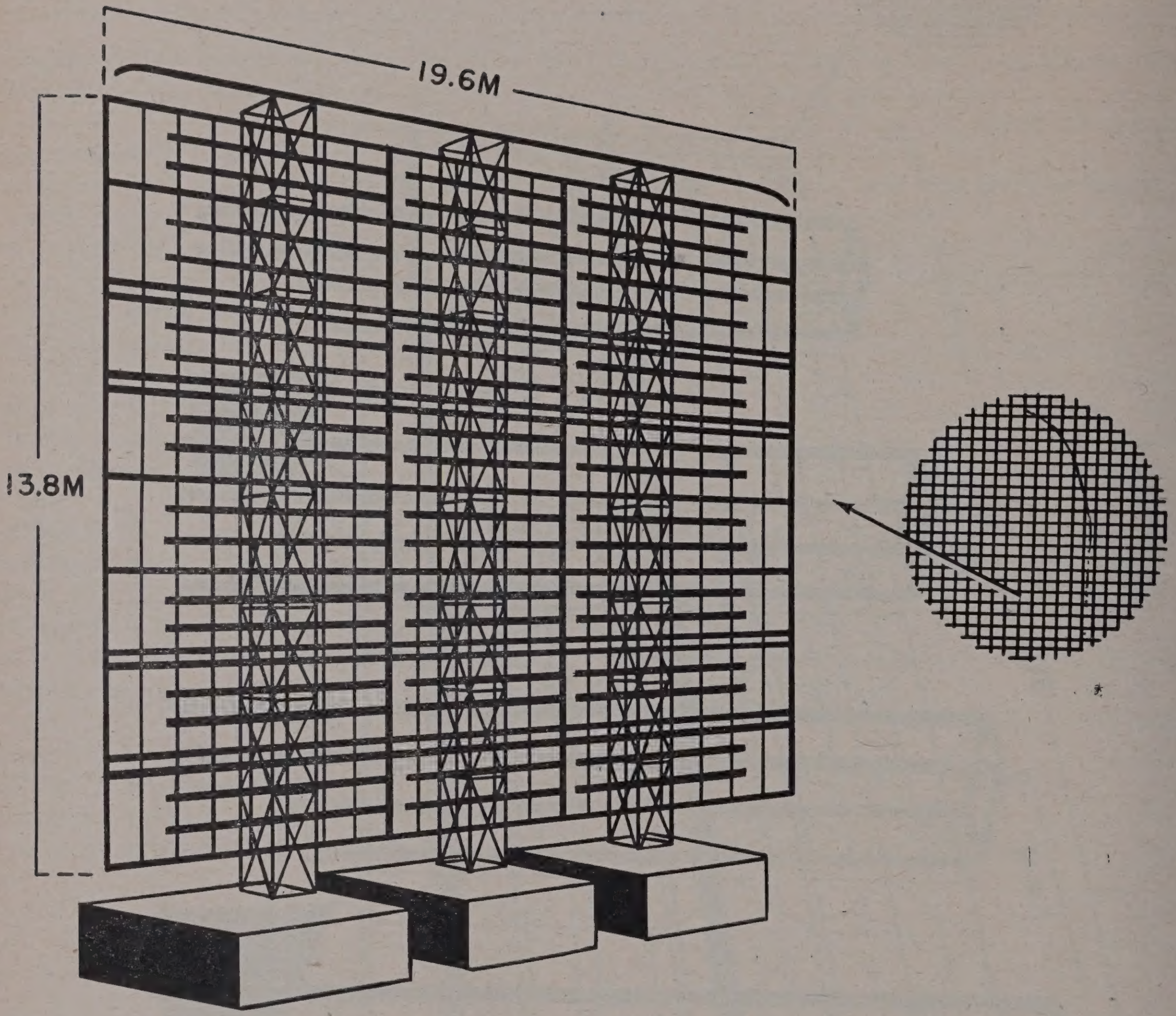
TUBES: Similar to Freya.

TOTAL WEIGHT: No information.


30.2 M
7.4 M
3.5 M
11.2M
16.2M

TL47741

Figure 27. Hoarding.



TL47742

Figure 28. Small Hoarding.

CHIMNEY (CYLINDER TYPE) (WASSERMANN) LONG-RANGE EW RADAR

The Chimney or Wassermann equipments, of which at least two versions are in operational use (the cylinder type and the girder type), are used for long-range aircraft reporting, measuring range and azimuth, occasionally for long-range interception, and possibly for long-range height-finding. The original model was erected in Norway to intercept courier planes (at long ranges) operating between Stockholm and London.

The cylinder type, most commonly used in northern Europe, is a permanent structure. The antenna array is hung on a rotatable hollow steel tower mounted on a partly buried concrete building. The cylinder is topped by a crane arm with block and tackle for hoisting the antenna array into position. IFF, with which the cylinder type is sometimes equipped, is an additional 23-foot extension to the top of the array.

Scanning with the large Chimney is done by mechanical rotation (horizontal) and possible phase control (vertical). Beam width is estimated at 20° and 14°, zero to zero, with common T&R and no "split."

Manufactured by Gema, the cylinder-type Chimney was introduced into service in 1942; approximately 25 were in service by the end of 1943.

Characteristics of the cylinder-type Chimney are as follows:

RANGE (miles): 180.

FREQUENCY RANGE (mc): 116 to 146; 120 to 150 also reported.

PULSE RECURRENCE FREQUENCY (cps): 490 to 510.

PULSE LENGTH: 2.5 microseconds.

ANTENNA: Broadside array 98 feet high and 44 to 62 feet wide, supported on tubular mast 131 feet high and 8 inches in diameter. Array consists of vertically polarized full-wave dipoles backed by netting reflector. Common T&R.

POWER SOURCE: Power lines, also stand-by (portable) gas engine motor-generator sets.

SIMILAR SETS: Freyas and girder-type Wassermann.

POWER OUTPUT: 20 kw (peak).

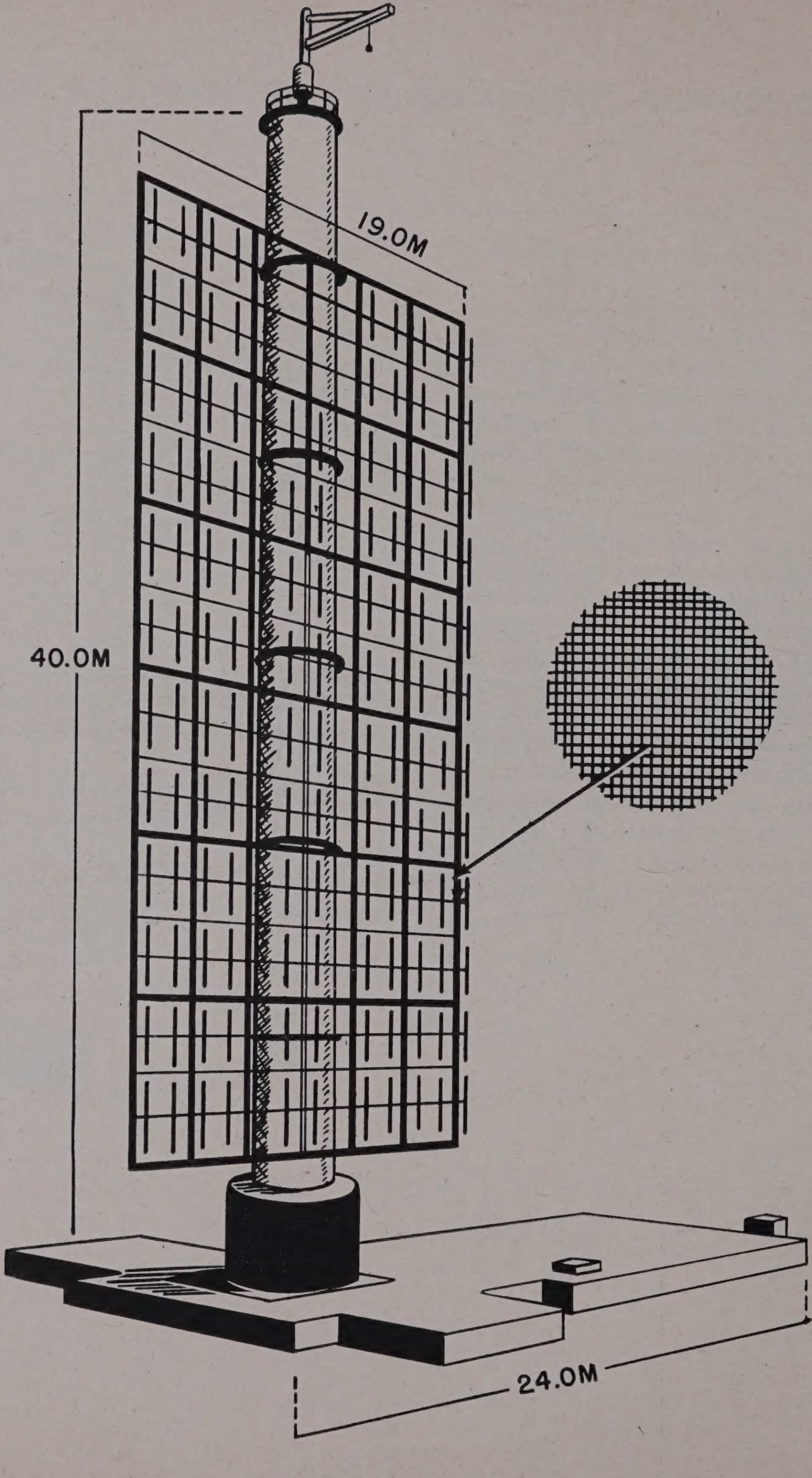

19.0M
40.0M
24.0M

Figure 29. Cylinder Chimney.

TL47744

CHIMNEY (GIRDER TYPE) (WASSERMANN L) LONG-RANGE EW RADAR

The small, girder-type Chimney or Wassermann L was commonly used in the Mediterranean area for long-range aircraft reporting. The main structure is a triangular section girder-work mast of light alloy, rising out of a short steel column the lower end of which rests in a socket on the ground. It is kept upright by several steel guy wires secured to the top. The cabin is built around the steel column and houses the radar equipment, turning gear, and operators.

A variation of this equipment, seen on a very few occasions in the Mediterranean area, is the so-called "box" type, distinguished by a square-section box girder supporting the aerial array. This girder is 16 feet square and nearly 120 feet high; about half-way up the girder is mounted a cubical cabin with sides about 12 feet long. The girder is mounted on a short stub on which it rotates; at the upper end of the girder, four corner pieces are brought together to form a cone 26 feet high, above which there is a 16-foot mast. Guys keep the equipment upright.

No details of the performance of the Wassermann L sets found in the Mediterranean area are available, but it is known to be superior to Freya performance at long range. The accuracy of azimuth determination is not known. Scanning is by electrical rotation, with alternative hand drive for the horizontal plane. Low-cover, high-cover change-over is accomplished by a motor-driven phasing unit which changes the beam elevation from horizontal to plus 2½° to provide high cover. There is no intermediate position. Beam width is 40° from zero to zero. Most of the Wassermann sets of the girder type that have been found have been sited at altitudes of 200 feet.

Manufactured by Gema, the Wassermann L was introduced into service in 1942; by the end of 1943, there were an estimated 20 in service.

The characteristics of the girder-type Chimney are as follows:

RANGE (miles): 186 (maximum); 65 (20,000-foot target).

FREQUENCY RANGE (mc): 120 to 150.

PULSE RECURRENCE FREQUENCY (cps): 500.

PULSE LENGTH: 2 to 3 microseconds.

ANTENNA: Broadside rotating array, vertically polarized, 98 feet high and 20 feet wide, divided into two stacks of four sections, each having three rows of three full-wave dipoles. Array is supported on rotating triangular trellis mast built from light steel girders. It is similar to that of cylinder-type Chimney.

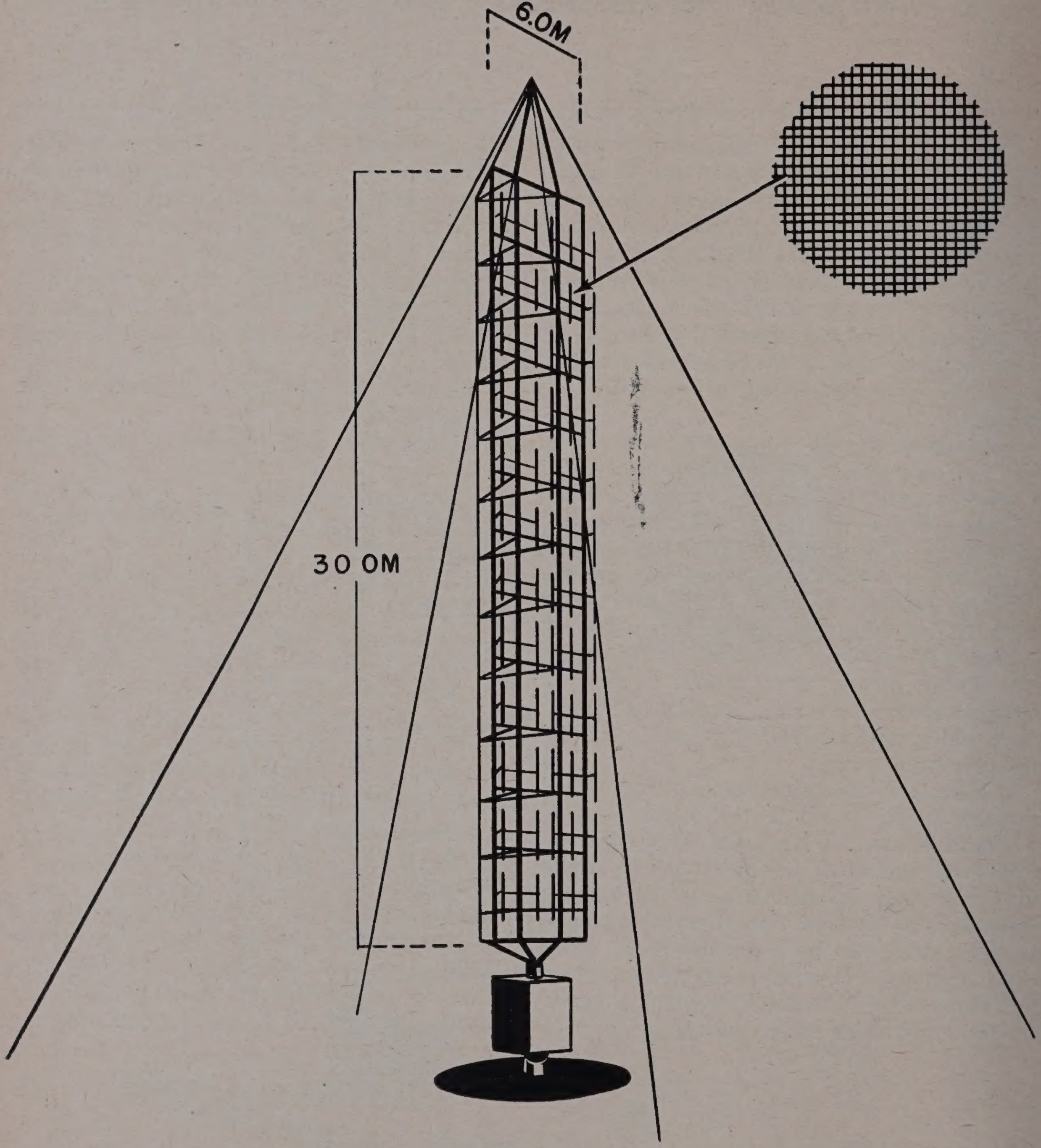
POWER SOURCE: Power lines or stand-by motor-generator sets.

SIMILAR SETS: Other Wassermanns.

POWER OUTPUT: 20 kw (peak).

TRANSPORTATION: Although this is not a fixed installation, there is only vague information on how it is moved. Probably it is broken into sections and moved by truck.

DATA OBTAINED: Range and azimuth.



TL47743

Figure 30. Girder Chimney.

COASTWATCHER (SEETAKT) RADAR (EW TYPE VS. SHIPS)

The Coastwatcher, or Seetakt, as its name implies, is a Naval set used for ship detection, although it can be used also for coastal gunlaying. There is also evidence that Seetakt stations are being used to supplement the aircraft reporting chain. A fixed-station set, its mounting is normally similar to the Limber-type Freya; like the Freya, the entire set is rotated in azimuth in searching for targets.

The Seetakt has an effective beamwidth of 10°. It is normally sited on high ground in a circular emplacement with a square extension on the landward side. Its performance against shipping depends to a great extent on the elevation of the site and on the size of the surface vessel, large vessels being detected at 32 miles from an elevation of 500 feet and small vessels at 19 miles from the same site. Its performance against low-flying aircraft should be almost equivalent to that of the Giant Würzburg. For aircraft tracking between 1,000 and 10,000 feet, performance is similar to that of a Freya; at 20,000 feet, there would be a weakness in cover due to limitation of its radiation to low angles of elevation.

The Seetakt transmitter, in weatherproof case, is mounted adjacent to the antenna that it serves. It is in two sections, one above the other, and is fed from the main power pack of the station. A closed-circuit air cooler (Kuhlgerät) is mounted on top of the case. The oscillator unit TU 106 is in the upper portion of the case; the lower compartment contains the modulator unit TS 103, the filament transformer unit TN 103 (Netzteil), both removable, the filament rheostat 182, and the EHT bleeder chain 176–181.

The transmitter is remarkable because of its simplicity of operation and absence of adjustments, but the output is very low compared with American and British standards. The modulator, producing the final modulating pulse from the master sine wave in only two stages, is especially worthy of notice, but the form of the output pulse of this modulation is not ideal, and the r-f pulse controlled by it is only 15 kw.

The only tuning adjustment in the entire transmitter is that of the tuning loop in the oscillator chassis, and this appears to be merely to keep it to the preset frequency after a change of tubes.

Although there are many points of similarity between this and the Freya transmitter, especially as regards the modulator and the Netzteil units, there is no interchangeability of parts between the two equipments.

The Seetakt receiver is similar to the Freya receiver. In the Seetakt receiver, the signal frequency of 375 mc is converted to 15 mc without prior amplification, but the subsequent stages are exactly similar to those of the Freya receiver. The entire output is plugged into the display unit housing, connections being made automatically between fixed sockets on the latter and plugs at the rear of the receiver.

A variant of the Seetakt is the so-called "large" Coastwatcher, which consists of a rotating cabin surmounted by a tall square girder structure to which the aerial frames are attached. The aerial system may look something like that indicated in the pictorial view.

Manufactured by Gema, the Seetakt was introduced into service in 1939.

The characteristics of the Coastwatcher are as follows:

RANGE (miles): 30, against ships, depending upon elevation of set.

FREQUENCY RANGE (mc): 350 to 390 (a spot frequency 375).

PULSE RECURRENCE FREQUENCY (cps): 500.

PULSE LENGTH: 2 to 3 microseconds.

ANTENNA: One Freya frame supports transmitting and receiving arrays, each of which consists of a horizontal bank of 16 full-wave vertical dipoles backed by wire-netting reflector and rotatable about a vertical axis. Vertical polarization. A larger array is used in some installations.

POWER SOURCE: Power lines, also stand-by motor-generator sets.

SIMILAR SETS: Freya (Limber type); large Coastwatcher.

POWER OUTPUT: 15 kw.

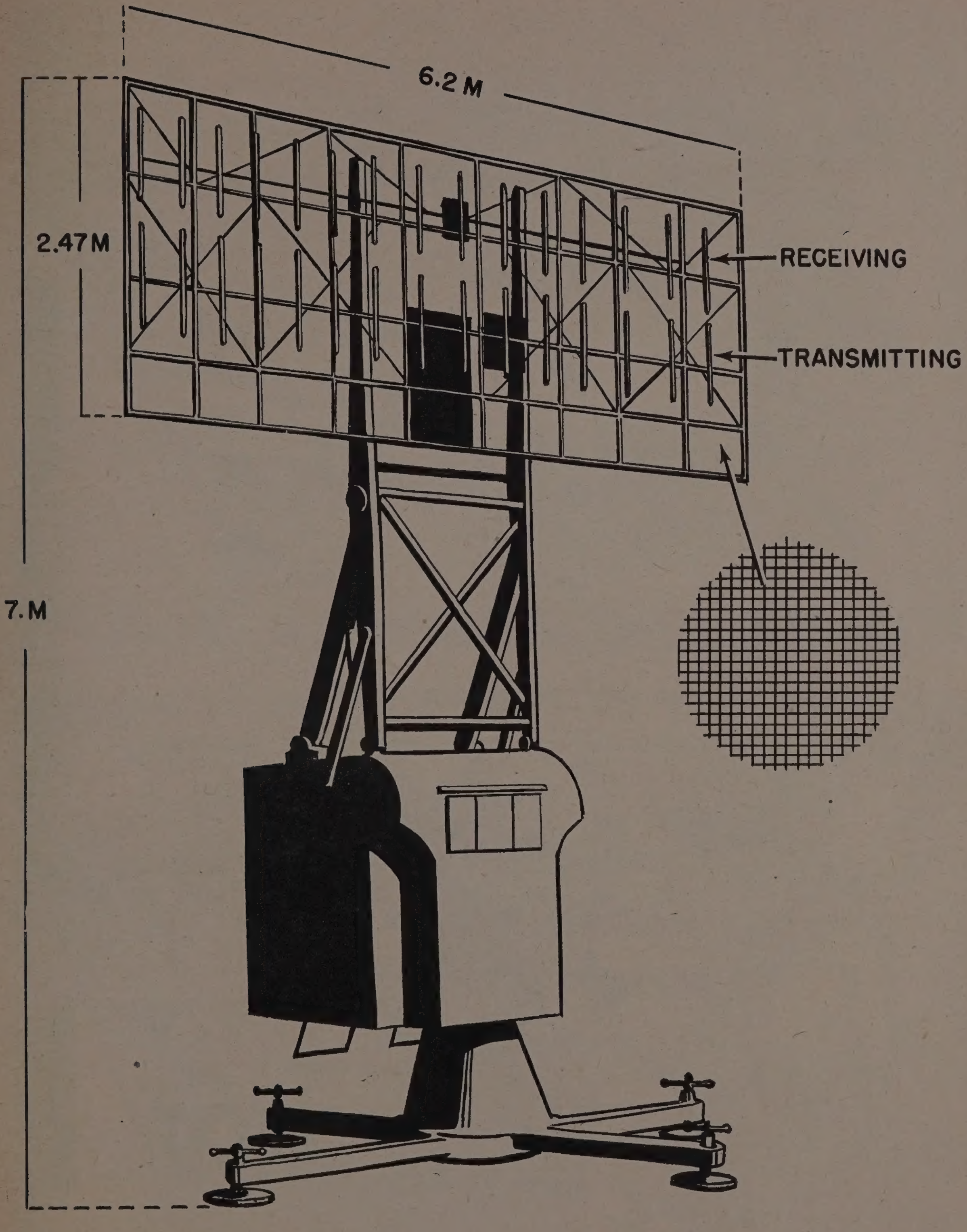
TYPE OF PRESENTATION: General observation tube and high-speed trace tube for precision ranging. Precision measurement is by calibrated phase-shifter working on the sinusoidal deflector voltage of the high-speed trace.

DATA OBTAINED: Range and azimuth.

ACCURACY: Of range, better than 1 mile; of azimuth, 0.2°.

TUBES (type and number): Transmitter, two LS 50 oscillator tubes.

TOTAL WEIGHT: 6.87 tons.


6.2 M
2.47 M
7. M
RECEIVING
TRANSMITTING

TL47745

Figure 31. Coastwatcher.

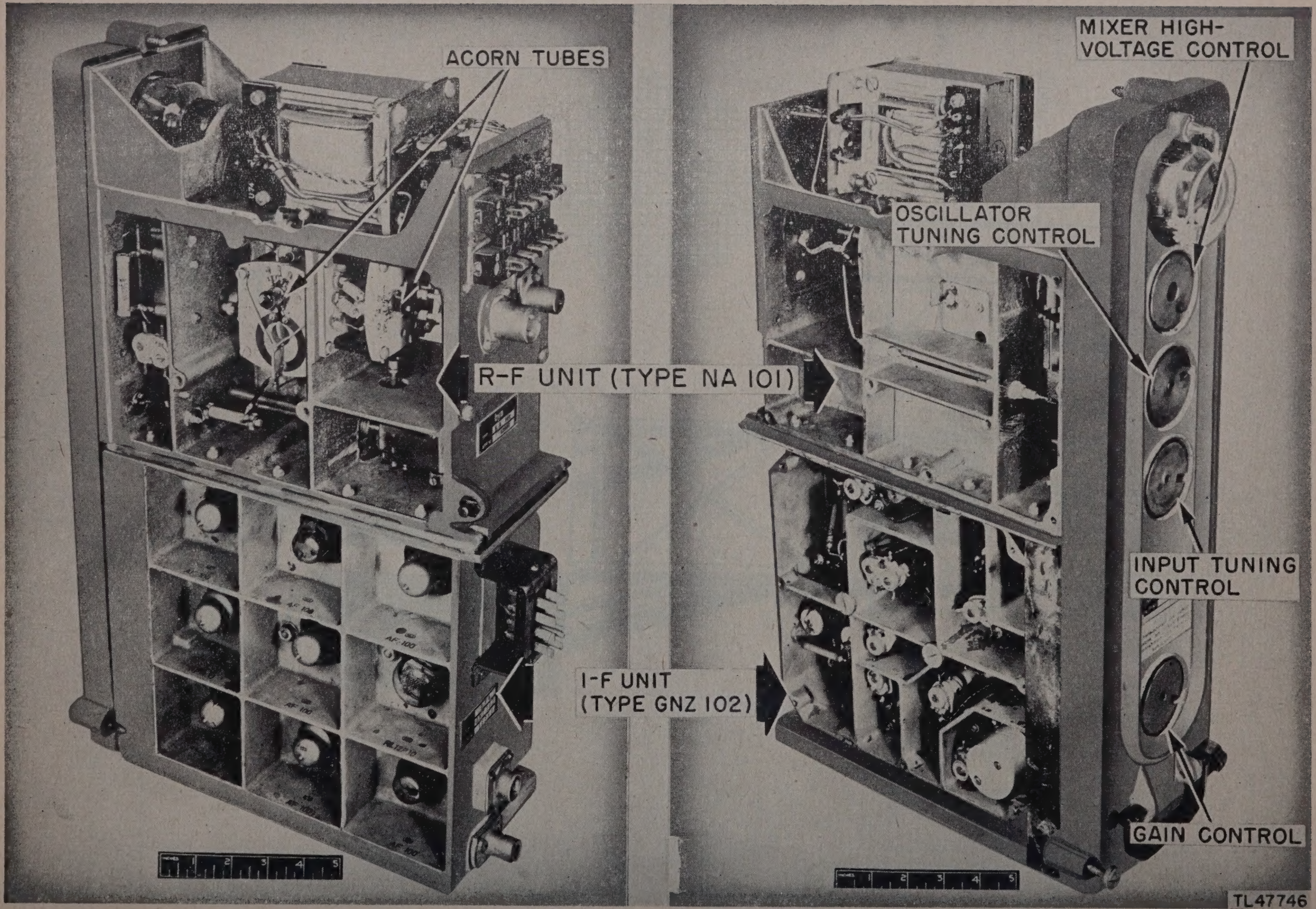
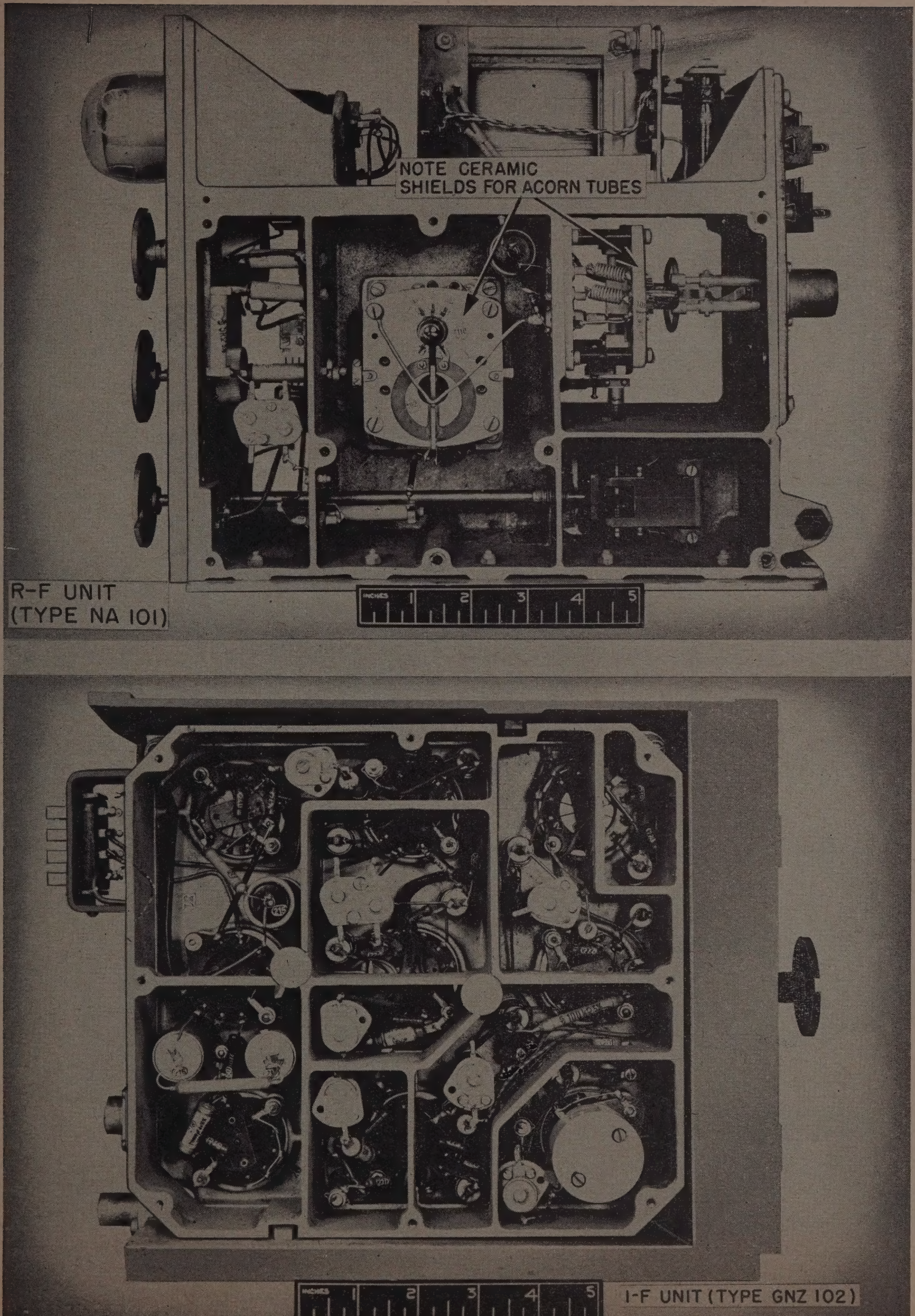

ACORN TUBES
R-F UNIT (TYPE NA 101)
I-F UNIT (TYPE GNZ 102)
MIXER HIGH-VOLTAGE CONTROL
OSCILLATOR TUNING CONTROL
INPUT TUNING CONTROL
GAIN CONTROL
TL47746

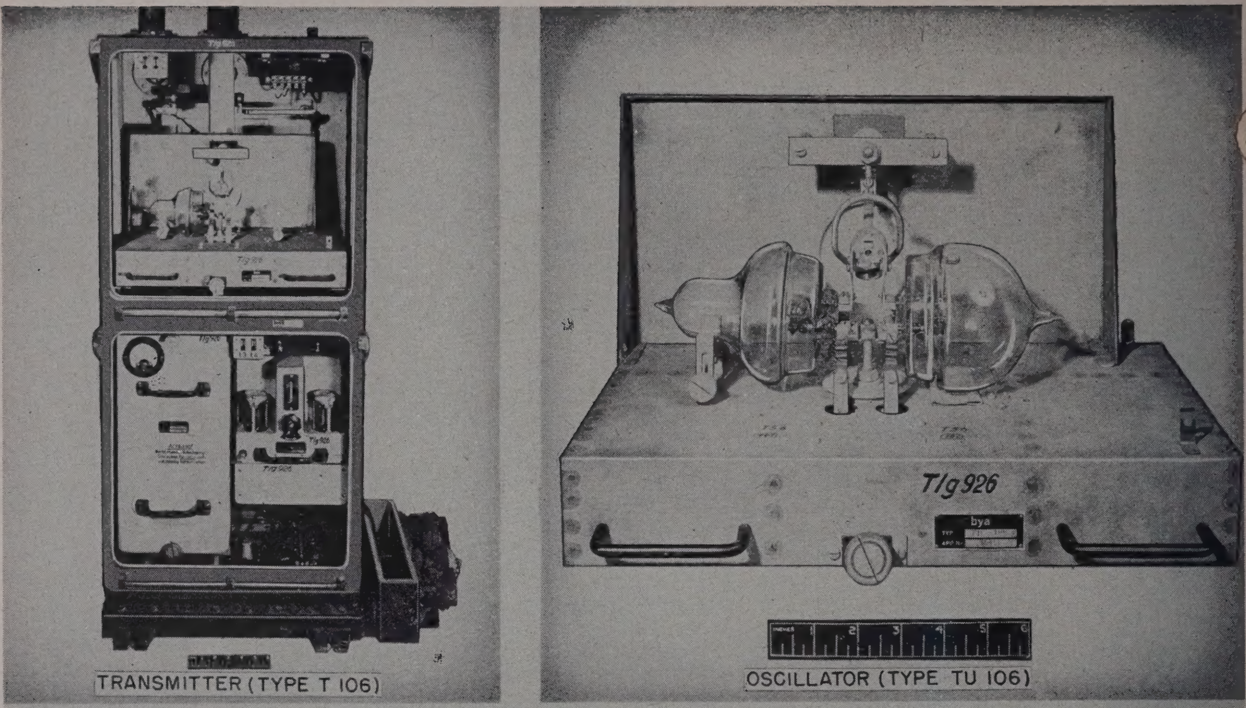
Figure 32. Coastwatcher receiver (side covers removed).



NOTE CERAMIC SHIELDS FOR ACORN TUBES

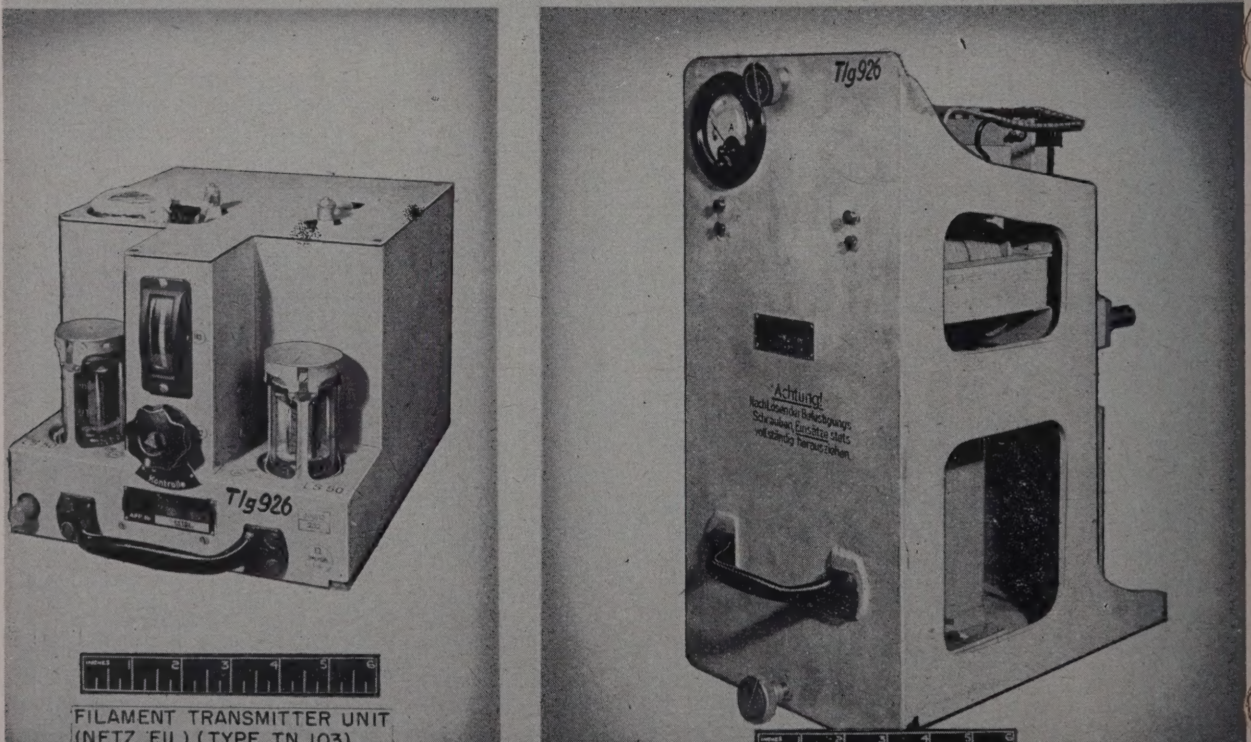
R-F UNIT
(TYPE NA 101)
INCHES 1 2 3 4 5
INCHES 1 2 3 4 5
I-F UNIT (TYPE GNZ 102)
TL47747

Figure 33. Coastwatcher receiver.


TRANSMITTER (TYPE T 106)

OSCILLATOR (TYPE TU 106)

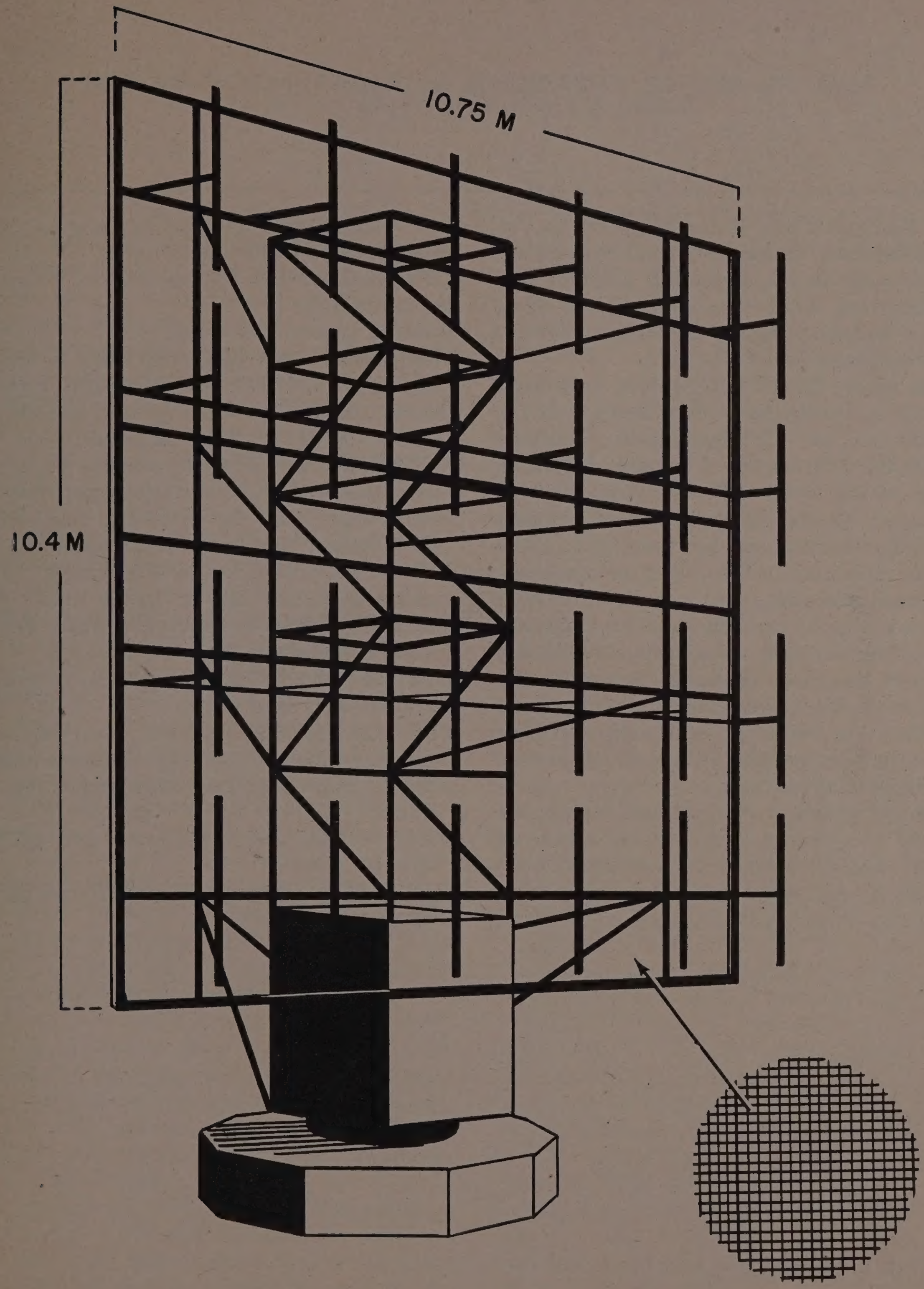
T/g 926
bya
INCHES
1
2
3
4
5
6


FILAMENT TRANSMITTER UNIT (NETZ EIL) (TYPE TN 103)

MODULATOR (TYPE TS 103)

T/g 926
Kontrolle
LS 50
Achtung!
Nachlösen der Befestigungs-
Schrauben Einsätze stets
vollständig herausziehen.
INCHES
1
2
3
4
5
6
TL 47748

Figure 34. Coastwatcher.


10.75 M
10.4 M

TL47749

Figure 35. Large Coastwatcher.

FMG 39L AND 40L (WÜRZBURG) GL RADAR (NOT STANDARD)

This equipment was designed by Lorenz, but not standardized, as an early Flak, gun-laying set. A few are in use on coastal sites for aircraft reporting, a few were given to the Navy for coast-watching duties, and about 10 were sold to the Italians.

These types, FMG 39L and 40L, have been described as consisting of two bowls, one for reception and one for transmission, mounted on a movable arm on top of a cabin containing the rest of the equipment. The lower bowl is the receiver. Display comprises one CRT with two circular traces, one for bearing and the other for elevation. In operation, the bowls are moved until maximum pip is obtained on each trace; readings of elevation and bearings are indicated mechanically in accordance with the position of the bowls. The pips appear on the periphery of the traces immediately opposite each other. As the range of the objective increases, the pips move in unison in a clockwise direction around the tube.

To obtain range, a plotting cursor from the center of the tube is laid over the center of the pips, and is extended to a celluloid scale calibrated in km fitted around the outside of the tube.

The equipment is manned by three operators accommodated inside the cabin.

The characteristics of the Lorenz Würzburg are as follows:

RANGE (miles): 15 to 22.

FREQUENCY RANGE (mc): 560 to 580.

PULSE RECURRENCE FREQUENCY (cps): 5,000; reduced to 3,000 on later models.

PULSE LENGTH: 2 microseconds.

ANTENNA: Two 10-foot parabolic mirrors of wire mesh, one for transmitting and the other (the upper one) for receiving; focal length 29.5 inches. Horizontal polarization.

POWER SOURCE: Gasoline-engine driven motor-generator sets or power lines.

SIMILAR SETS: Würzburgs manufactured by Telefunken about the same time.

TRANSPORTATION: Mounted on four-wheel trailer with fixed cabin.

TYPE OF PRESENTATION: Two concentric circular timebases on tube, the outer indicating azimuth and the inner indicating elevation.

DATA OBTAINED: Elevation and azimuth (range is scaled).

ACCURACY: Of range, 55 yd; of azimuth, 1°; of elevation, 6°.

FMG 39T (A) (WÜRZBURG) GL RADAR

FMG 39T (A), (C), and (D) are small (Bowl Fire) types of Würzburg. All can perform all duties involving measurement of small ranges, such as the detection of nearby aircraft and shipping, the control of Flak, and, in some instances, the control of searchlights.

FMG 39T (A) is the basic Würzburg design, manufactured by Telefunken and introduced into the service in 1940. This type is used in coastal and inland sites in northwest Europe and the Mediterranean area, principally for gun-laying; it can also be used for short-range early warning of aircraft and for height-finding in aircraft reporting. Würzburgs and Freyas are frequently sited in the same neighborhood, the Freya to give early, long-range warning of the approach of aircraft and the Würzburg to obtain height measurements and to follow at close range.

This type has no lobe switching; it uses only one CRT, azimuth and elevation being determined by maximum pip amplitude. The transmitting tube is a triode with approximately 8-kw peak power. The i-f amplifier has four stages at 25 mc, and five stages at 6 mc, the i-f bandwidth being 0.5 mc (–6 db). The local oscillator consists of push-pull triodes at 146.2 mc and quadrupler tube feeding capacity-resonator harmonic selector.

Most of the models are equipped with IFF receiving antennas (two dipoles with D/F facilities) at the sides of the paraboloid, operating on a frequency of approximately 155 mc. Although IFF is aural, the equipment has an auxiliary visual signal strength meter. It allows D/F on a minimum.

The apparatus consists of a small antenna with parabolic reflector, transmitter and receiver in a small hut, mounted on a trailer that can be folded back and held in position by bars. It is so delicately balanced that a spirit level or plumb line is a necessary part of the equipment. The unit is of light alloy; it is extremely simple and robust; construction and workmanship are good. In general, ease of operation has been sacrificed for simplicity, since the paraboloid has to be tilted by hand.

The hut (or "cupboard") and reflector can be rotated horizontally through 360° and the antenna and reflector can be tilted in a vertical plane from 15° below to about 75° above the horizontal. It has a narrow circular field of view, about 14°, and has to be forewarned of the approach and approximate position of the target. This may be done by a controller or by a neighboring Freya. After receiving the warning, the Würzburg is turned in the direction of the target, which it may perceive at a distance of from 25 to 30 miles.

All types of Würzburg can measure height by calculating the range of the target and the angle of elevation of the reflector required to produce the maximum response at the receiver. Ranges are accurate to less than 1 mile and elevation to less than 1°. Aircraft can be detected at all but very low altitudes.

The characteristics of the FMG 39T (A) are as follows:

RANGE (miles): Normal, from 10 to 25; maximum, from 30 to 40. Minimum angle for accurate height-finding is from 5° to 10° above the optical horizon for inland sites.

FREQUENCY RANGE (mc): 520 to 590; 500 to 600 also reported.

PULSE RECURRENCE FREQUENCY (cps): 3,750, increased to 5,000 when IFF is used.

PULSE LENGTH: 2 microseconds; 1.5 microseconds when IFF is used.

ANTENNA: Sheet-metal paraboloid 10.1 feet in diameter, focal length 36.3″, with fixed tubular half-wave dipole and sheet-metal front reflector. Common T&R. Horizontal beamwidth 24°, vertical beamwidth 35° (estimated figures). Vertical polarization.

POWER SOURCE: Power lines through rotary converter; for standby a gasoline-driven generator. 90 to 380 volts, 40 to 60 cycles ac.

SIMILAR SETS: Other Würzburgs: types FMG 39T (C) and (D), both small types, and FMG 39T Riese (Giant).

POWER INPUT REQUIRED: 3 kw.

POWER OUTPUT: 7 to 11 kw (peak).

TUBES (type and number) : 75 tubes in transmitter-receiver unit FuSE 62 as follows: one LS 80, twelve LS 50, twelve LS 30, four LD 2, thirty-four RV 12, one LV 1, two LG 1, one LG 2, one LB 13/40, one LB 7/15, four neon lights TE 4, one quartz crystal OEK 1, and one stabilizer STV 150/15.

TRANSPORTATION: In light, four-wheel trailer with outriggers.

TYPE OF PRESENTATION: One CRT approximately 4″ in diameter, with circular timebase.

DATA OBTAINED: Range, azimuth, and elevation.

ACCURACY: Of range, 137.5 yd; of azimuth 1.8°; of elevation, 2°.

PRINCIPAL COMPONENTS

	DIMENSIONS			WEIGHT
	Height (*in.*)	*Width* (*in.*)	*Depth* (*in.*)	
Transmitter-receiver box	24½	10½	6¼	
Receiver i-f amplifier box	6½	7	12½	
Impulse generator	13	12¾	6¾	

Total weight of set.. 2.3 tons

(Dimensions are of the equipment captured in the Bruneval raid.)

FMG 39T (C) (WÜRZBURG) GL RADAR

Type FMG 39T (C) is a modification of the basic Würzburg design. It has a rotating dipole with synchronous antenna and indicator switching. Three CRT's are used: one large one with circular timebase for range measurement, and two smaller ones (azimuth and elevation tubes). Minimum angle of elevation for cover is 5° and for height-finding is 10° above the optical horizon for inland sites. A hand-rotated circular scale, calibrated from 2 to 16 km, is also provided. Setting the pointer of this scale to the same range as that indicated in the range tube brings the correct echoes into the smaller tubes for aiming.

There is also a push button by means of which the operator can change the pulse repetition frequency from 3,750 to 5,000 cps in order to enable the aircraft IFF to function.

Type FMG 39T (C) is used at most Seetakt sites in northwest Europe. It is used mainly for Flak control, for searchlight control (via the plotting instrument "Malsi"), height-finding for aircraft reporting, or as stand-by in interception control.

This set was introduced into service in 1941.

The characteristics of this equipment are as follows:

RANGE (miles): From 1 to 25.

FREQUENCY RANGE (mc): "A" band, 550 to 580; "B" band, 470 to 490; intermediate band, 545 to 555; 520 to 590 also reported.

PULSE RECURRENCE FREQUENCY (cps): 3,750 increased to 5,000 when used with IFF.

PULSE LENGTH: 1 to 2 microseconds.

ANTENNA: Sheet-metal paraboloid 10.1 feet in diameter, with wide-band dipole of sheet-metal blades; blade-fixing holes slotted for adjustment at approximately 21.2 inches or 25.2 inches working. Alternative narrow-band dipole on some specimens. Front reflector is 3.2-inch strip of sprayed metal on bakelite disk, 3.1 inch in front of dipole. Common T&R.

POWER SOURCE: 90 to 380 volts, 40 to 60 cycles a-c from power lines or standby motor-generator set or both.

SIMILAR SETS: Würzburg: FMG 39T (A) and (D) and FMG 39T Riese (Giant).

POWER INPUT REQUIRED: 3.3 kw.

POWER OUTPUT: 7 to 11 kw (peak).

TUBES (type and number): 75 tubes in transmitter-receiver unit FuSE 62 as follows: One LS 80, twelve LS 50, twelve LS 20, four LD 2, thirty-four RV 12, one LV 1, two LG 1, one LG 2, one LB 13/40, one LB 7/15, four neon lights TE 4, one quartz crystal OEK 1, and one stabilizer STV 150/15.

TRANSPORTATION: Mobile; it can be carried in truck or trailer.

TYPE OF PRESENTATION: Three CRT's: one large, with circular timebase for range measurement and two smaller ones, elevation and azimuth tubes.

DATA OBTAINED: Range, elevation, and azimuth.

ACCURACY: Of range, 137.5 yd; of azimuth, 0.2°; of elevation, 0.2° (estimated).

	Height	*Width*	*Length*
Over-all dimensions of set:	102 in.	120 in.	211 in.

FMG 39T (D) (WÜRZBURG) GL RADAR

Type FMG 39T (D) is the latest model of the small Würzburg. It was introduced into service in 1942.

Like types (A) and (C), it is equipped with IFF. In addition, it has the facility for *precision range* finding, provided by an additional CRT.

When the IFF is in operation, the PRF is changed from 3,700 to 5,000 cps; this apparently makes the radar completely inoperative during interrogation. The signal at 5,000 cps actuates FuG 25, which transmits a 20-mc signal with keyed 1,000-cycle modulation which is received on two dipoles mounted on either side of the paraboloid. From these antennas, the signal passes through a commutator to insure that the signal is from the plane at which the paraboloid is pointed. A normal receiver is then used to give aural indication (headphones) and visual indication (meter). A small antenna placed on the paraboloid indicates by means of diode rectification and a meter that the set is transmitting; a PS 62 test transmitter is used to show that the receiver is in operation.

The transmitting tube is a triode, type LS 180, with approximately 8-kw peak output power. The receiver is a double superheterodyne.

This type of Würzburg is probably used for detecting surface vessels. It is used also for Flak fire control, gun-laying, searchlight control, and height-finding for aircraft-reporting and as stand-by in ground control of interception.

The characteristics of the FMG 39T (D) are as follows:

RANGE (miles): 1 to 25.

FREQUENCY RANGE: (mc): "A" band, 550 to 580; "B" band, 470 to 490; intermediate band, 545 to 555; 520 to 590 also reported.

PULSE RECURRENCE FREQUENCY (cps): 3,750, increased to 5,000 when used with IFF.

PULSE LENGTH: 1 to 2 microseconds.

ANTENNA: Common T&R. Sheet-metal paraboloid 10.1 feet in diameter with side-band dipole of sheet-metal blades; blade-fixing holes slotted for adjustment at approximately 21.2 inches or 25.2 inches working. Alternative narrow-band dipole on some specimens. Front reflector is a 3.2 inch strip of sprayed metal on bakelite disk 3.1 inches in front of dipole.

POWER SOURCE: 90 to 380 volts, 40 to 60 cycles ac from power lines or standby motor-generator set or both.

SIMILAR SETS: Würzburgs: types FMG 39T (A), (C), and FMG 39T Riese (Giant).

POWER INPUT REQUIRED: 3.3 kw.

POWER OUTPUT: 7 to 11 kw (peak).

TUBES (type and number): 75 tubes in transmitter-receiver unit FuSE 62 as follows: one LS 80, twelve LS 50, twelve LS 30, four LD 2, thirty-four RV 12, one LV 1, two LG 1, one LG 2, one LB 13/40, one LB 7/15, four neon lights TE 4, one quartz crystal OEK 1, and one stabilizer STV 150/15.

TRANSPORTATION: Mobile, mounting similar to Freya Limber model.

TYPE OF PRESENTATION: Four CRT's, for azimuth, elevation, and range as in types (A) and (C). A fourth tube has been added for finer range readings; it has a single horizontal trace on which, by means of a control knob, an enlargement of any given sector of the range tube can be displayed and range in km read off in a small window indicator.

DATA OBTAINED: Range, elevation, and azimuth.

ACCURACY: Range accuracy approximates 11 yard; D/F accuracy 0.2° at all ranges. Precision ranging is accomplished by phase-shifter operating on the sinusoidal (30-kcps crystal-controlled) deflector voltage of the range strobe tube.

A variant of the FMG 39T is the FMG 41T, which resembles the FMG 39T (D), except that the paraboloid sometimes has a scooplike extension at the bottom, presumably to cut out ground echoes.

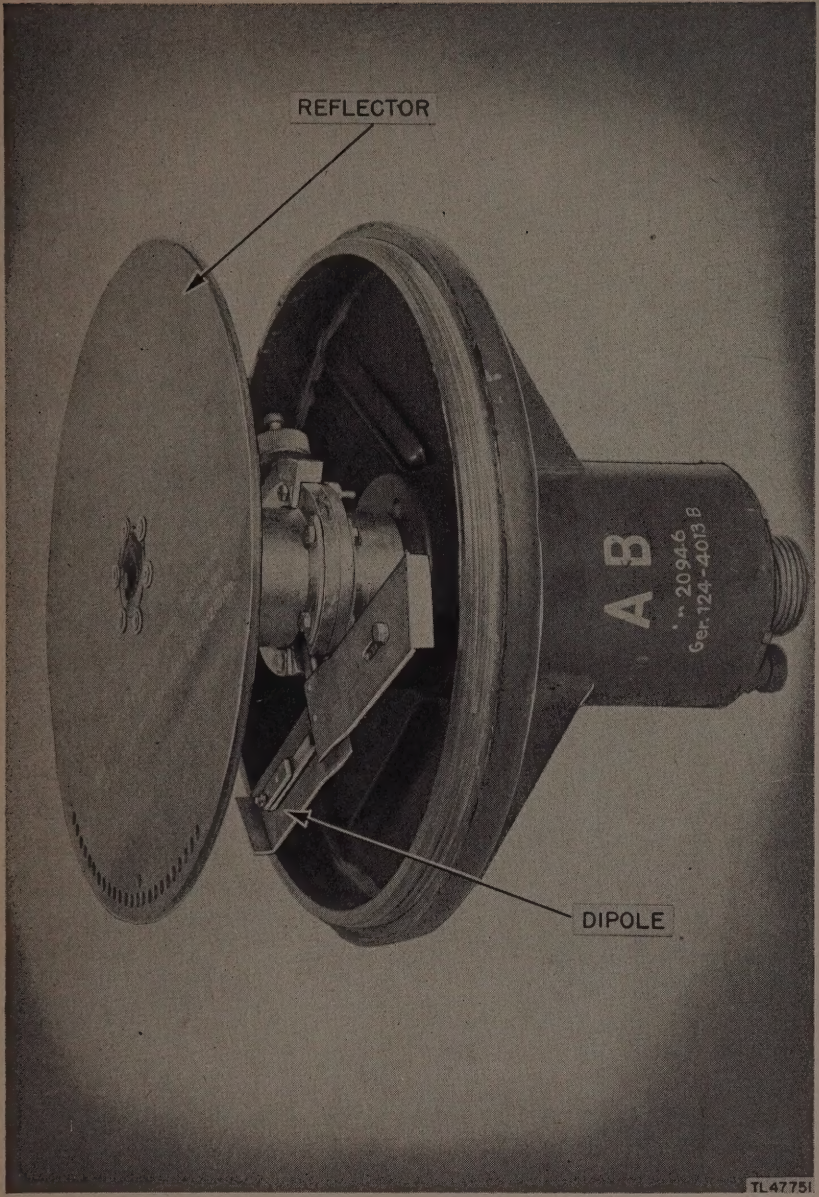

REFLECTOR
DIPOLE
A B
" 20946
Ger. 124-4013 B
TL47751

Figure 37. Rotary antenna—side view (cover removed).

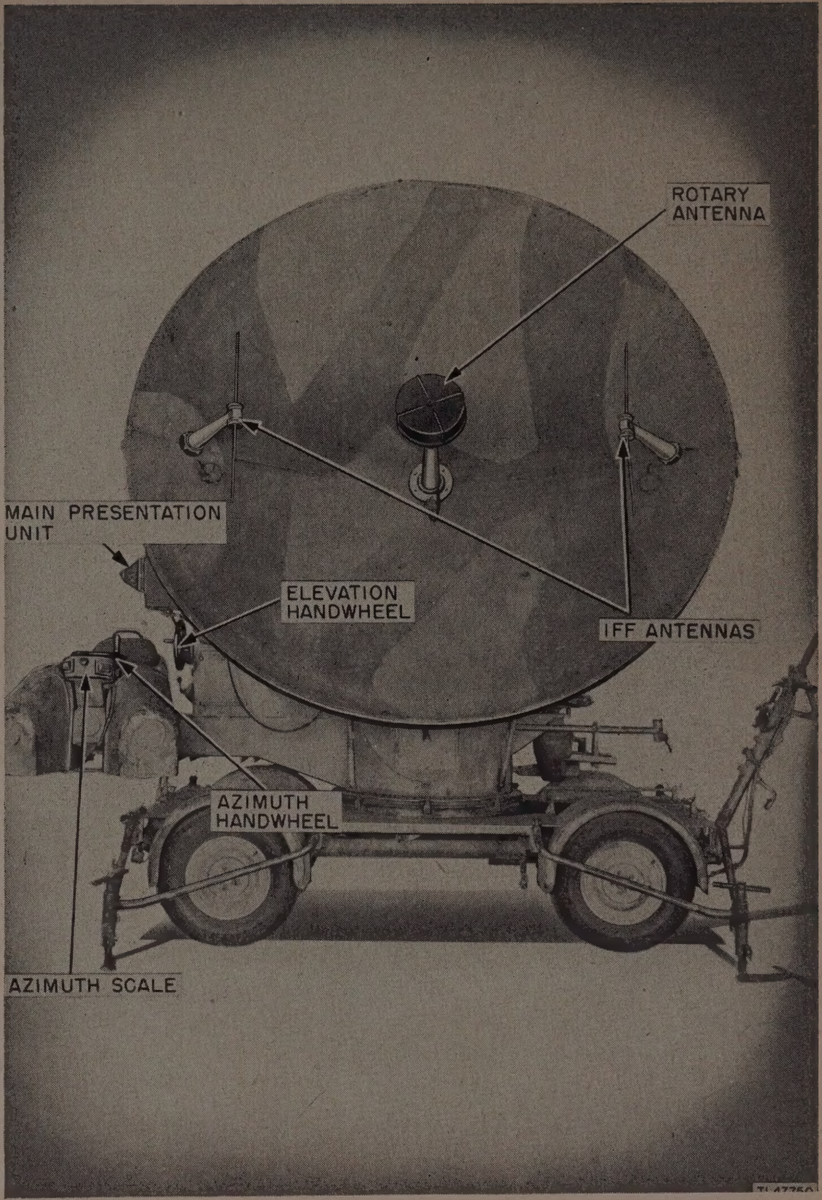

ROTARY ANTENNA
MAIN PRESENTATION UNIT
ELEVATION HANDWHEEL
IFF ANTENNAS
AZIMUTH HANDWHEEL
AZIMUTH SCALE

Figure 36. Würzburg (type D equipment on type A mount).

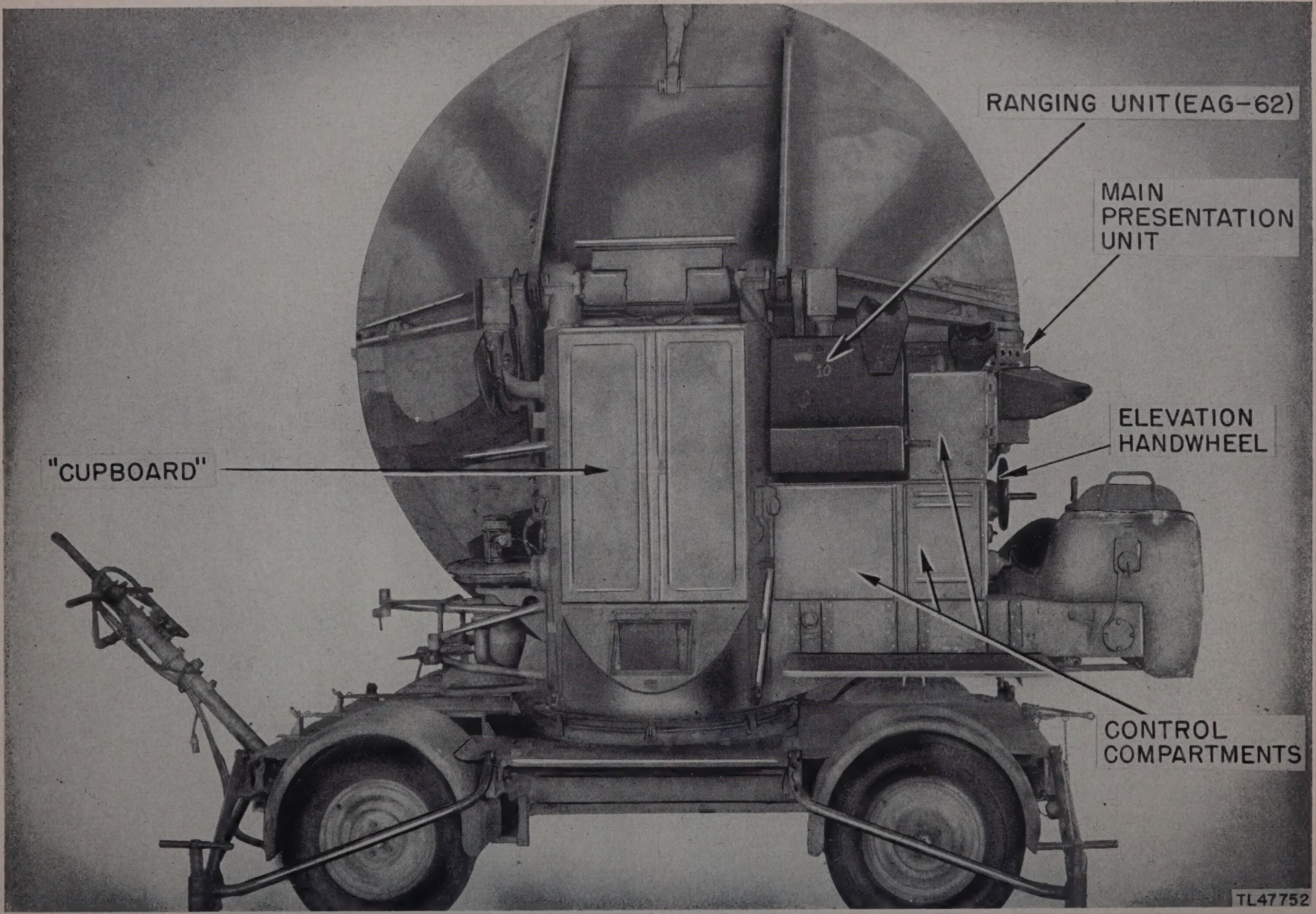

RANGING UNIT (EAG-62)
MAIN PRESENTATION UNIT
ELEVATION HANDWHEEL
"CUPBOARD"
CONTROL COMPARTMENTS
10
TL47752

Figure 38.

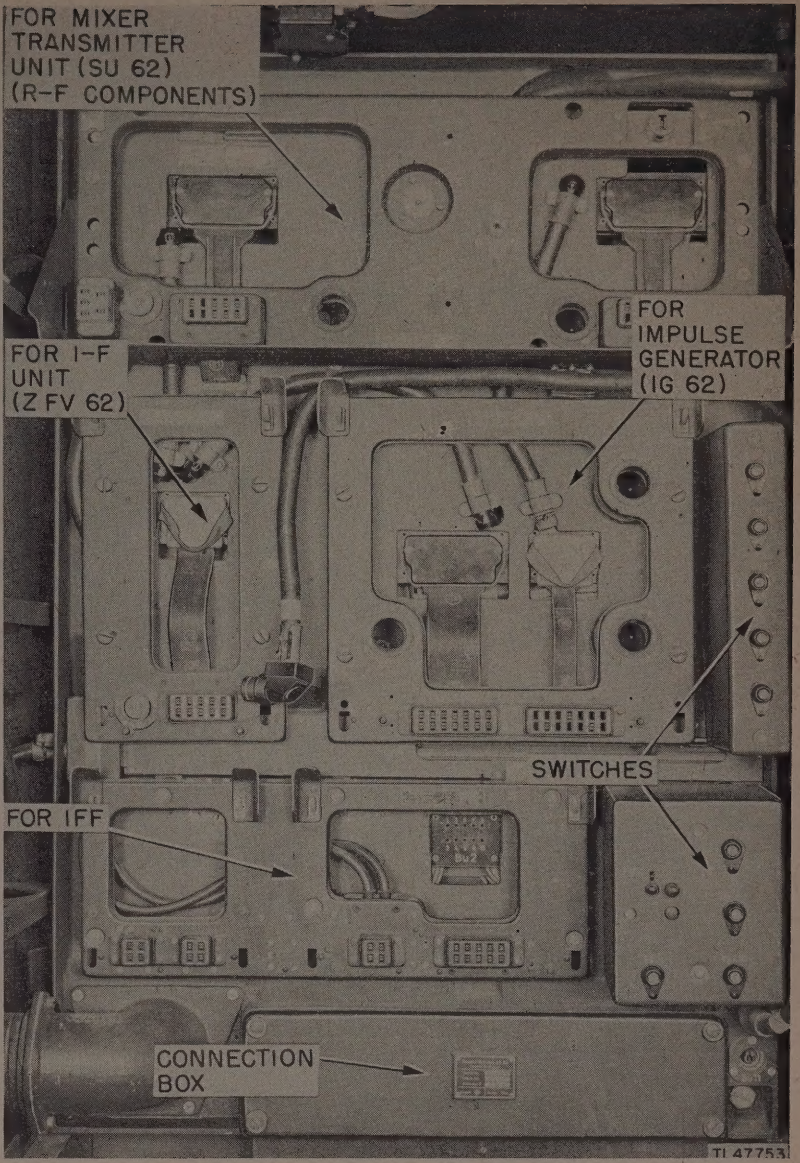

FOR MIXER TRANSMITTER UNIT (SU 62) (R-F COMPONENTS)
FOR IMPULSE GENERATOR (IG 62)
FOR I-F UNIT (Z FV 62)
SWITCHES
FOR IFF
CONNECTION BOX
TL 47753

Figure 39. Würzburg "Cupboard"—units removed.

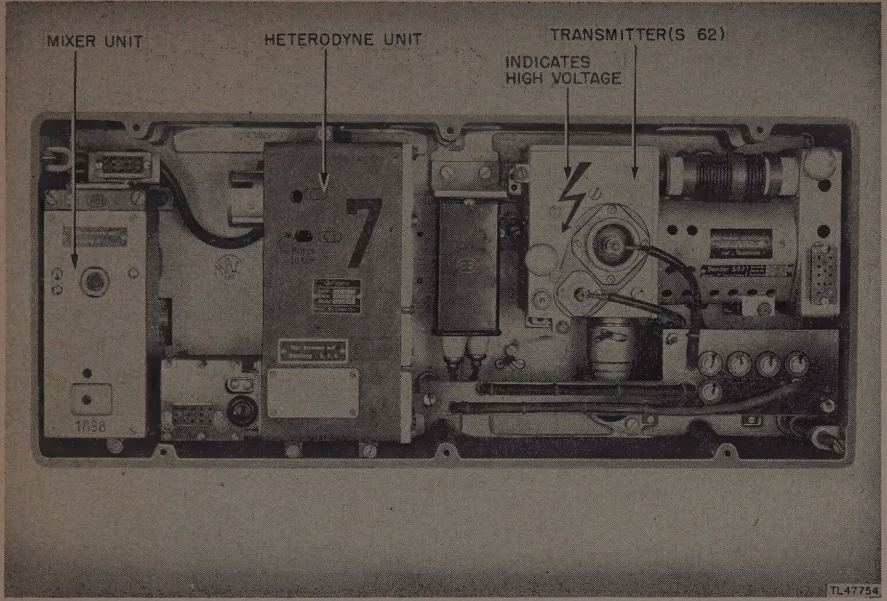

MIXER UNIT
HETERODYNE UNIT
INDICATES HIGH VOLTAGE
TRANSMITTER(S 62)
TL47754

Figure 40. Würzburg mixer—transmitter unit (SU 62)—front view.

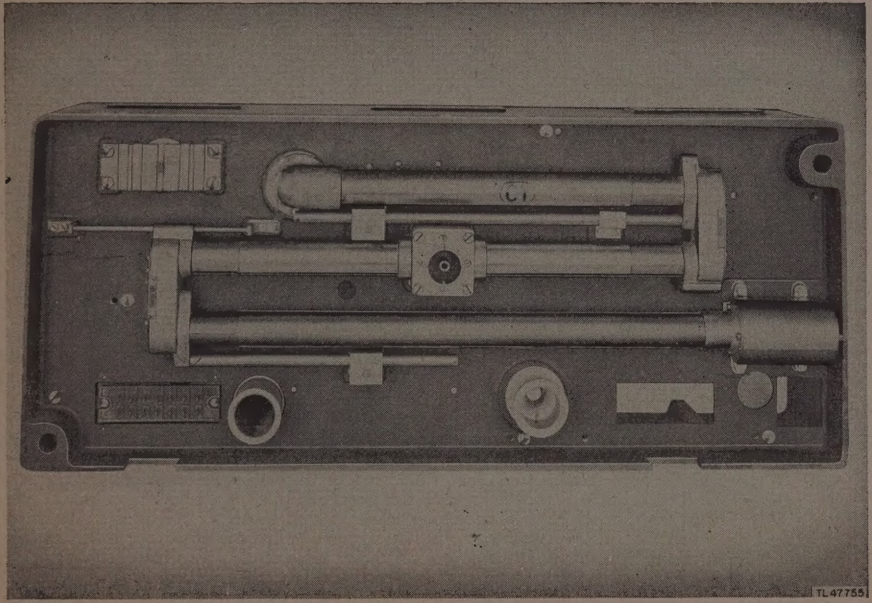


Figure 41. Mixer—transmitter unit (SU 62)—rear view, showing T-R box.

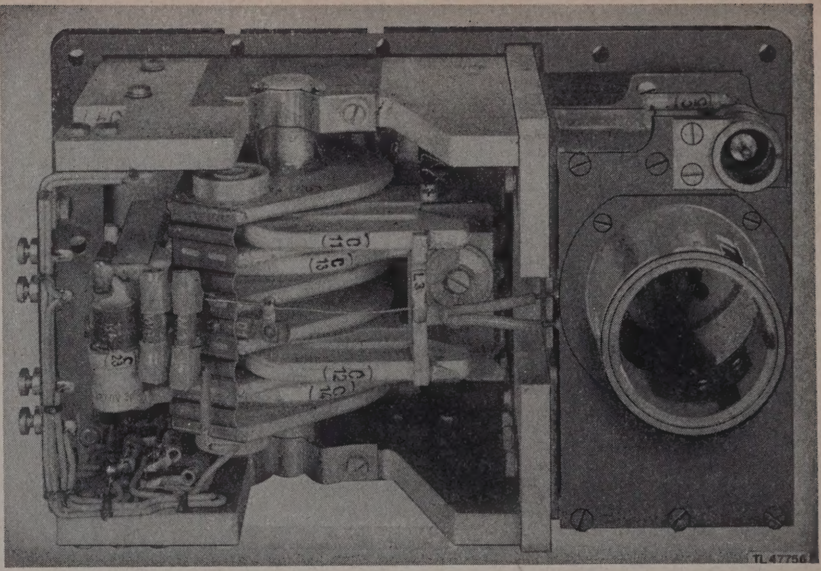

TL47756
L3
C 11
C 13
C 12
C 14
C 23

Figure 42. Heterodyne unit—face view.

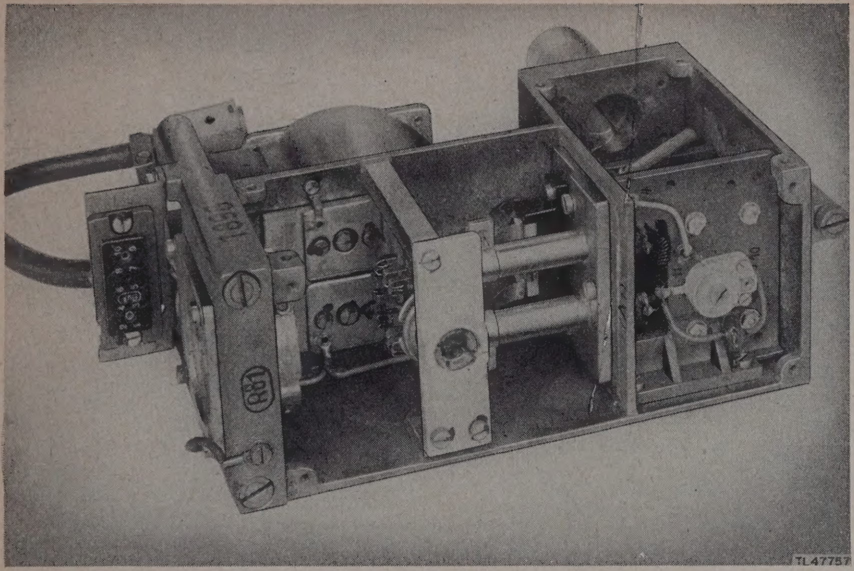

TL47757
Rö1
1850

Figure 43. Mixer unit—front view.

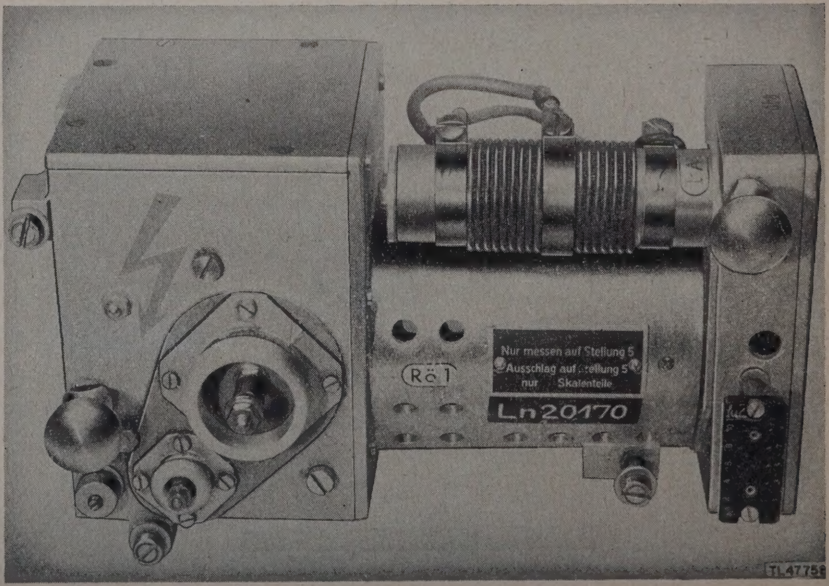

TL47758
Nur messen auf Stellung 5
Ausschlag auf Stellung 5
nur Skalenteile
Ln20170
Rö1
V1

Figure 44. Transmitter (S 62)—front view.

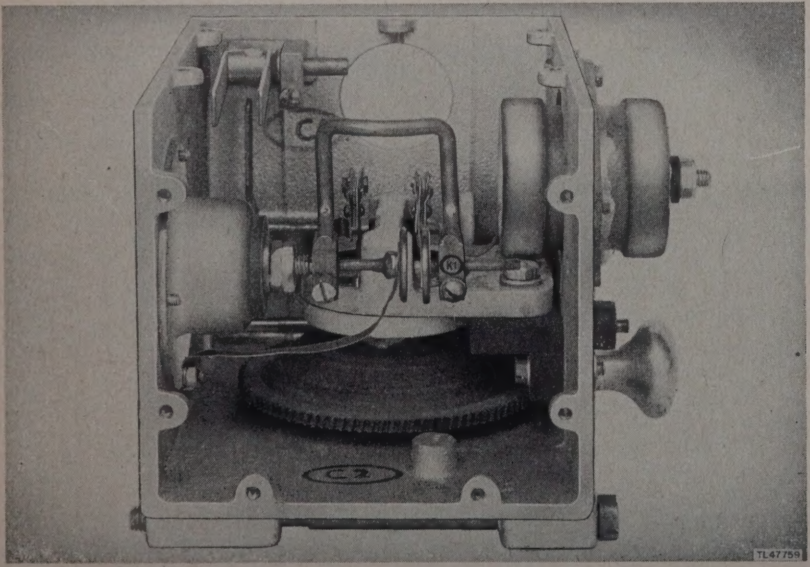

TL47759
C2
K1

Figure 45. Transmitter (S 62)—end view.

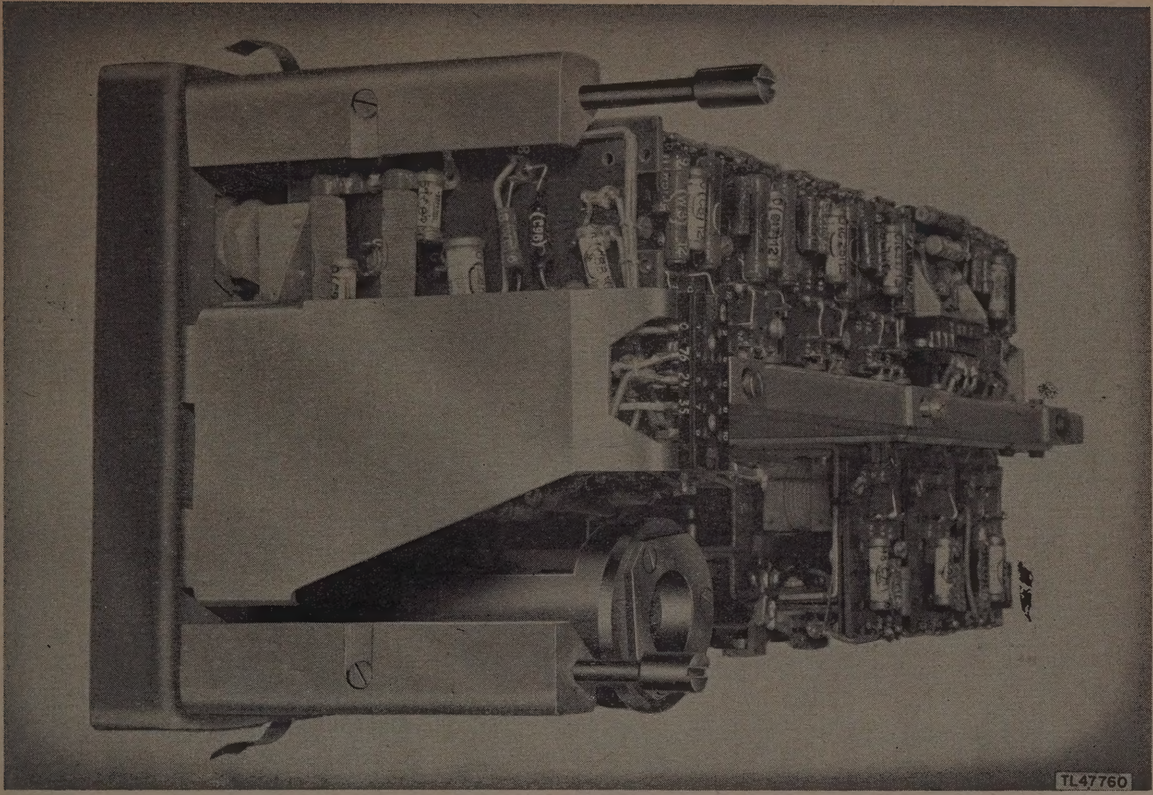


Figure 46. Würzburg i-f unit (ZFV 62)—end view.

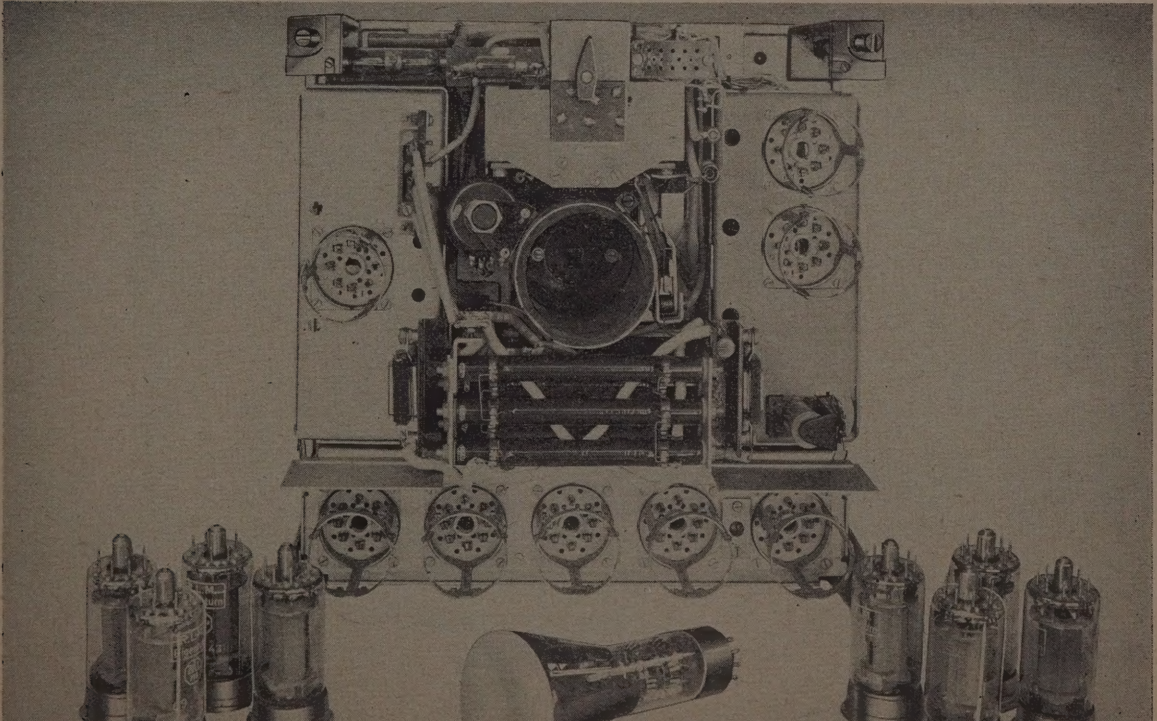


Figure 47. Würzburg impulse generator (IG 62)—front view.

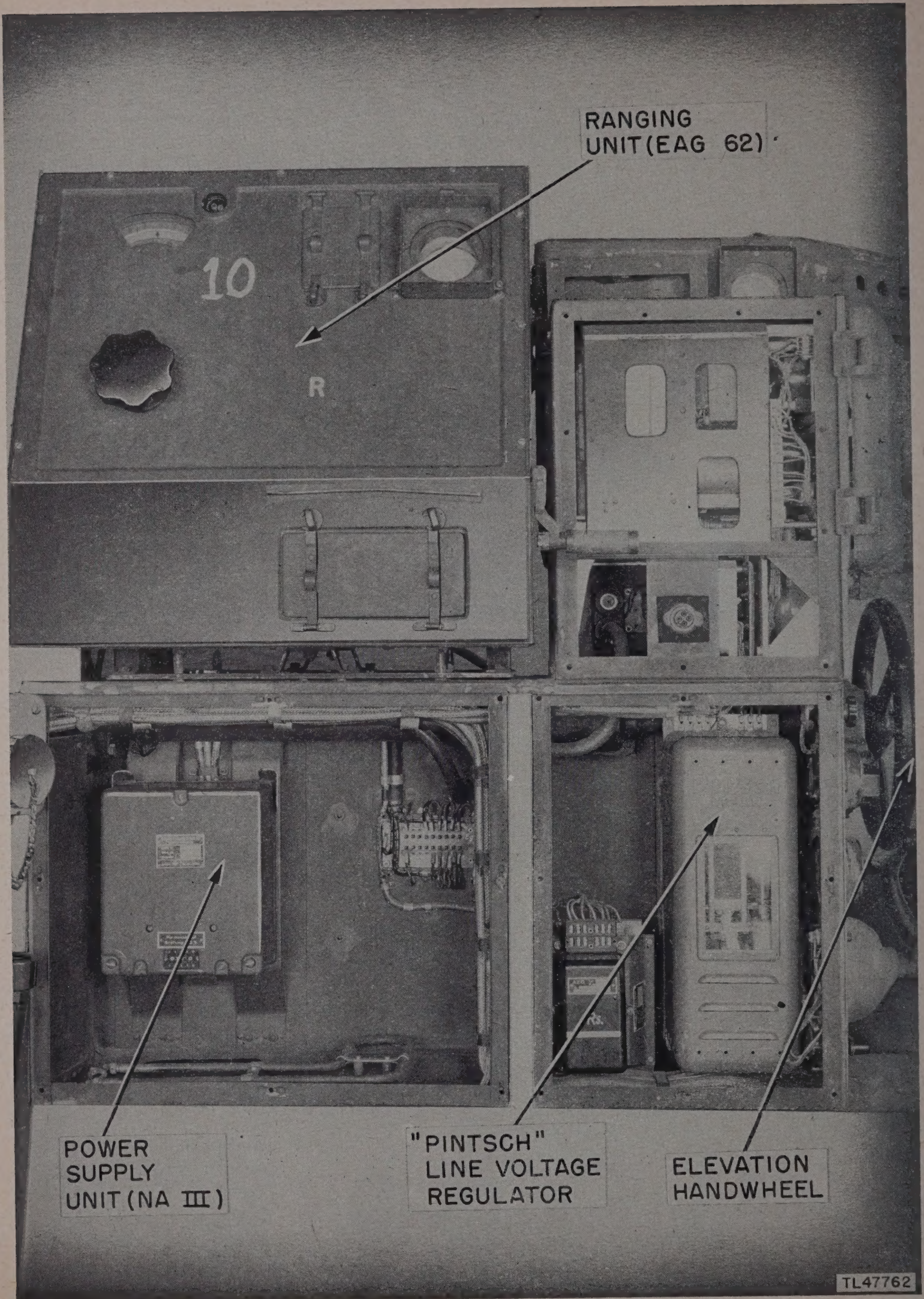

RANGING UNIT (EAG 62)
10
R
POWER SUPPLY UNIT (NA III)
"PINTSCH" LINE VOLTAGE REGULATOR
ELEVATION HANDWHEEL
TL47762

Figure 48. Würzburg control compartments.

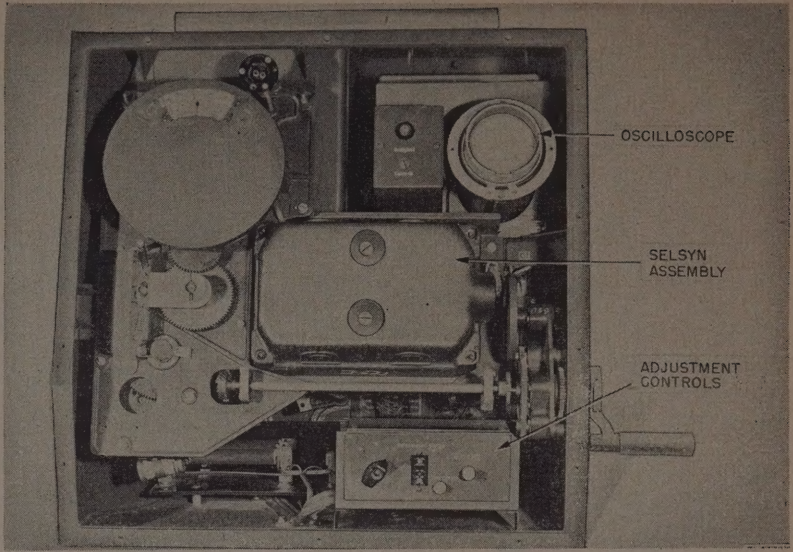

OSCILLOSCOPE
SELSYN ASSEMBLY
ADJUSTMENT CONTROLS

Figure 49. Würzburg ranging unit (EAG 62)—front view.

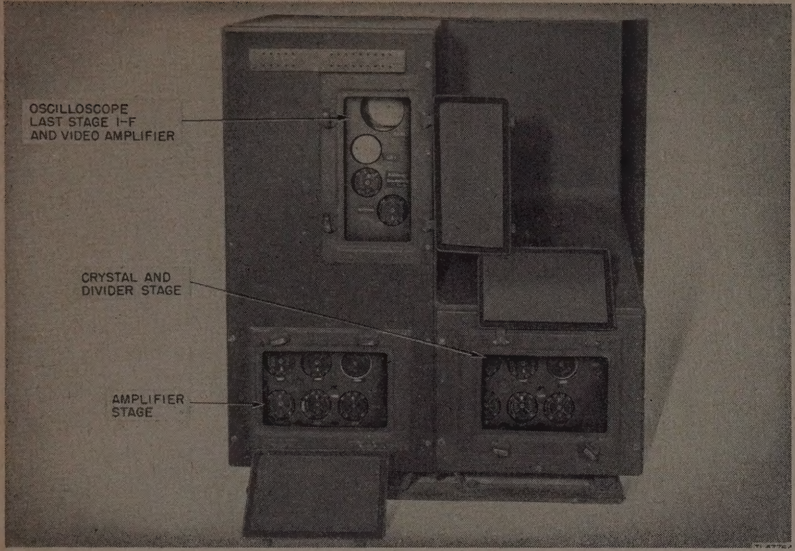

OSCILLOSCOPE LAST STAGE I-F AND VIDEO AMPLIFIER
CRYSTAL AND DIVIDER STAGE
AMPLIFIER STAGE

Figure 50. Würzburg ranging unit (EAG 62)—rear view.

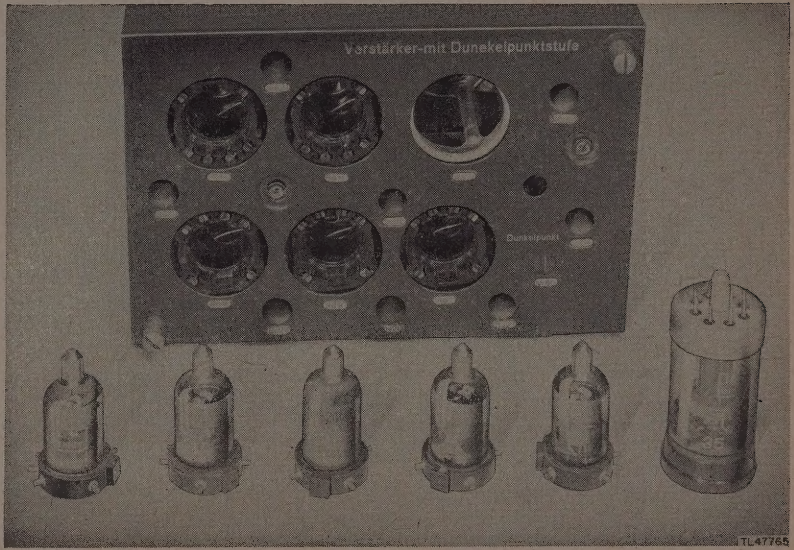

Verstärker-mit Dunekelpunktstufe
Dunkelpunkt
TL47765

Figure 51. Würzburg ranging unit (EAG 62)—Amplifier stage (front view).

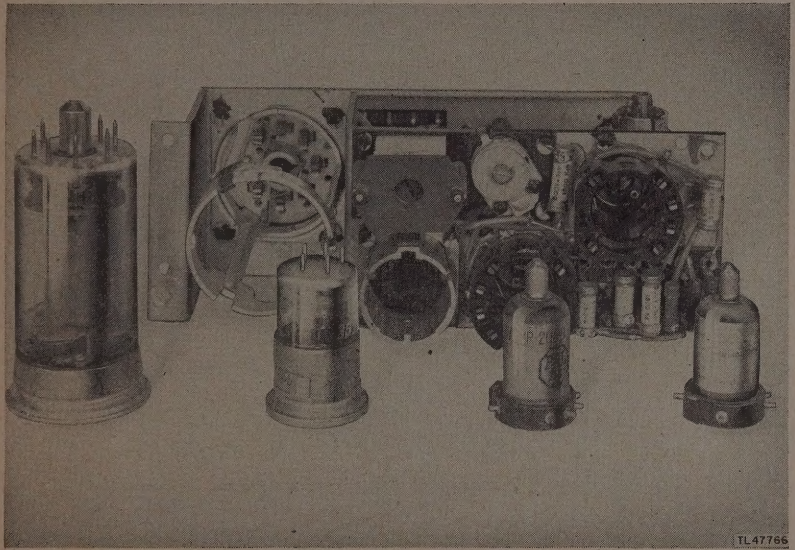


Figure 52. Würzburg ranging unit (EAG 62)—Oscilloscope, last stage i-f and video amplifier.

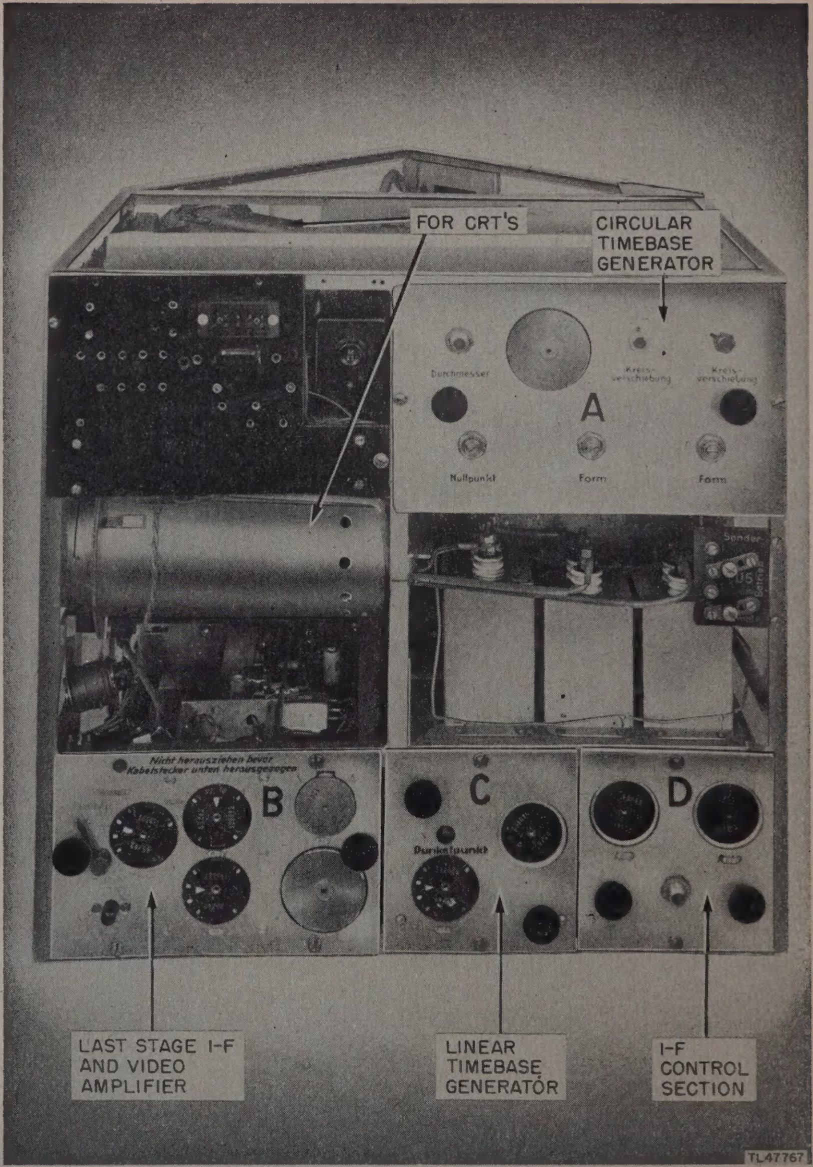

FOR CRT'S
CIRCULAR TIMEBASE GENERATOR
A
Durchmesser
Kreisverschiebung
Kreisverschiebung
Nullpunkt
Form
Form
Sender
Nicht herausziehen bevor Kabelstecker unten herausgezogen
B
C
D
LAST STAGE I-F AND VIDEO AMPLIFIER
LINEAR TIMEBASE GENERATOR
I-F CONTROL SECTION
TL47767

Figure 53. Würzburg main presentation unit.

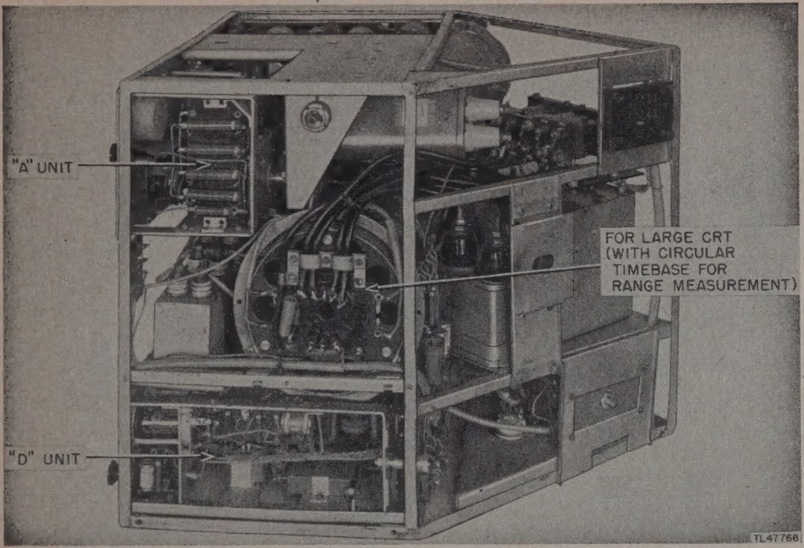

"A" UNIT
"D" UNIT
FOR LARGE CRT (WITH CIRCULAR TIMEBASE FOR RANGE MEASUREMENT)
TL47768

Figure 54. Würzburg main presentation unit—rear view.

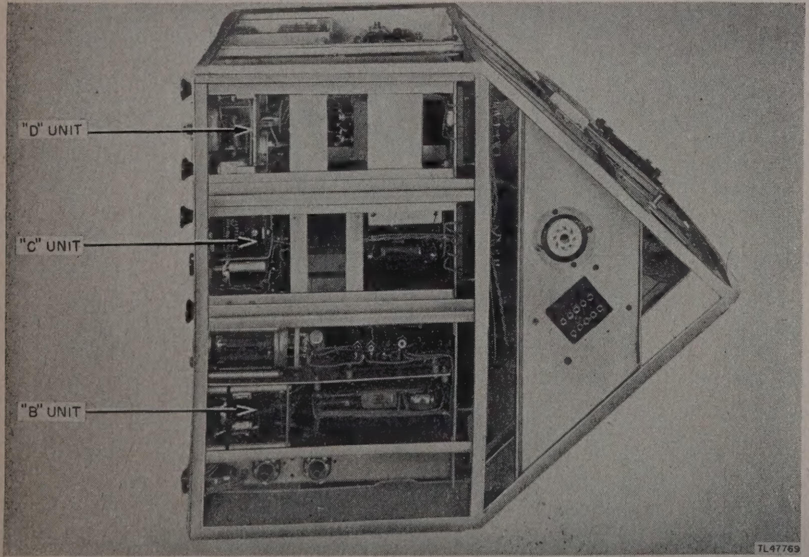

"D" UNIT
"C" UNIT
"B" UNIT
TL47769

Figure 55. Würzburg main presentation unit—bottom view.

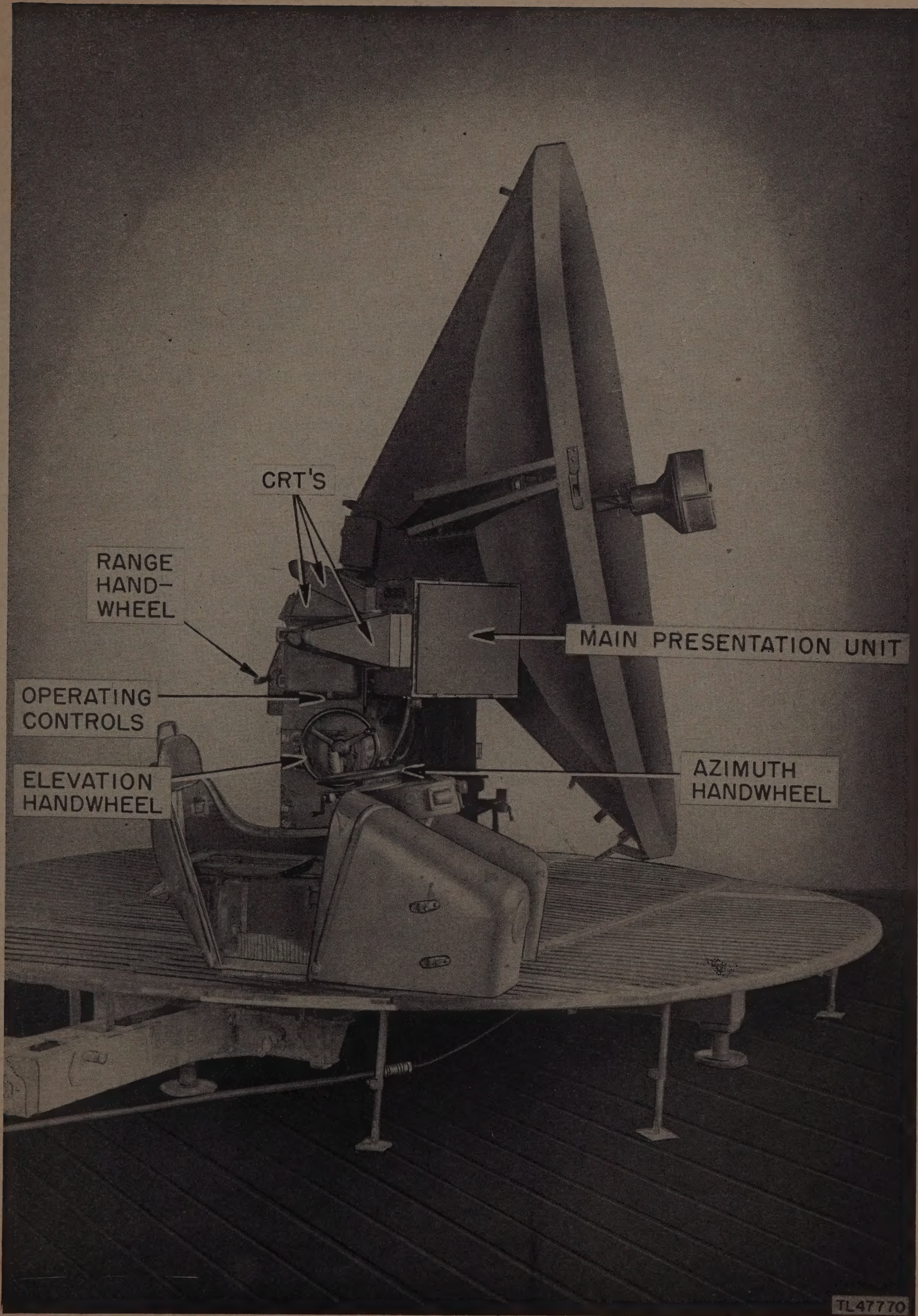

CRT'S
RANGE HAND-WHEEL
MAIN PRESENTATION UNIT
OPERATING CONTROLS
ELEVATION HANDWHEEL
AZIMUTH HANDWHEEL
TL47770

Figure 56. Würzburg type D.

FMG 39T RIESE (GIANT WÜRZBURG) GCI AND GL RADAR

The Giant or "Basket" Würzburg is a normal Würzburg modified by a large (14 times the wavelength) parabolic reflector of wire mesh which is capable of working up to 50 miles and of giving accurate height measurements by virtue of its narrow beam (7°). Like other Würzburgs, it uses a common receiving and transmitting dipole at the focus of the reflector.

From a recently captured unit, it was learned that the Giant Würzburg may be tuned to one of three wavebands, each waveband containing three spot frequencies. The bands are identified by the letters A, B, and C, and the spot frequency settings of each band by the numbers 7, 4, and 1, which are marked at appropriate positions on a dial.

Giants and ordinary Würzburgs are sometimes used for sea watching in conjunction with the standard 80-cm set. When so used, polarization is horizontal, and pulse recurrence rate is 1,500 cps.

One of the earliest functions of the Giant was in fighter control (GCI) stations, the major components of which consist of one Freya, two Giants, one type (C) Würzburg for stand-by, one communication radio-receiver, stand-by power facilities, radio beacon, and plotting room equipment (Seeburg Tizch). The Giants are used for interception, one to follow the target and the other to follow the night fighter. A total of from 120 to 150 men is needed to operate the station, 18 being used for each Würzburg set.

Giants are capable of good performance as early-warning sets against low flyers, the actual performance being governed by the elevation of the site. With the Giant at less than 100 feet and the aircraft at 2,000 feet, the range of pick-up would be 60 miles; corresponding figures for sites above 200 feet would be 80 miles and up. At 500 feet, large vessels could be picked up at 38 miles and small ones at 27 miles.

The radio portions of the Giant were manufactured by Telefunken, the mechanized parts by Luftschiffbau Zeppelin and Weserhutte, and the turning gear by Allgemeine Elektrizität Gesellschaft (AEG). This set was introduced into service in 1941.

The characteristics of the Giant Würzburg are as follows:

RANGE (miles): From 37.5 to 50.

FREQUENCY RANGE (mc): Three bands, A, B, and C, between 500 and 600 mc.

PULSE RECURRENCE FREQUENCY (cps): 1,750.

PULSE LENGTH: 1.0 microsecond.

ANTENNA: Common T&R type, using a single wide-band dipole of sheet metal blades with blade-fixing holes slotted for adjustment to 21.2 inches or 25.2 inches working. Front reflector consists of a strip of sprayed metal on bakelite disk 3.1 inches in front of dipole. Used with a 24.6-foot diameter parabolic reflector of sheet metal or wire mesh.

POWER SOURCE: Power lines, 90 to 380 volts, 40 to 60 cycles ac, or stand-by motor-generator sets.

SIMILAR SETS: Other Würzburgs: types (A), (C), and (D). The main difference between the Giant and the small types is in the size of the reflector.

POWER INPUT REQUIRED: For the apparatus, 3.3 kw; for the turning gear, 12 kw.

POWER OUTPUT: 8 to 11 kw (peak).

TUBES (type and number): 75 tubes in transmitter-receiver unit FuSE 62 as follows: one LS 80, twelve LS 50, twelve LS 30, four LD 2, thirty-four RV 12, one LV 1, two LG 1, one LG 2, one LB 13/40, one LB 7/15, four neon lights TE 4, one quartz crystal OEK 1, and one stabilizer STV 150/15.

TO REPLACE IN PART: Coastwatcher (for medium-range EW) and small Würzburg (for fire control).

TRANSPORTATION: Fixed installation.

TYPE OF PRESENTATION: Four displays: two Class A range tubes with a dark strobe adjustable to range of target, and two Class B tubes for elevation and azimuth respectively.

DATA OBTAINED: Range, elevation, and azimuth.

ACCURACY: The Giant measures height accurately down to about 2.5° of elevation. This limit corresponds roughly to 5,000 feet at 20 miles, 10,000 feet at 40 miles and 12,000 feet at 50 miles.

OVER-ALL WEIGHT (without foundation): 13.3 tons.

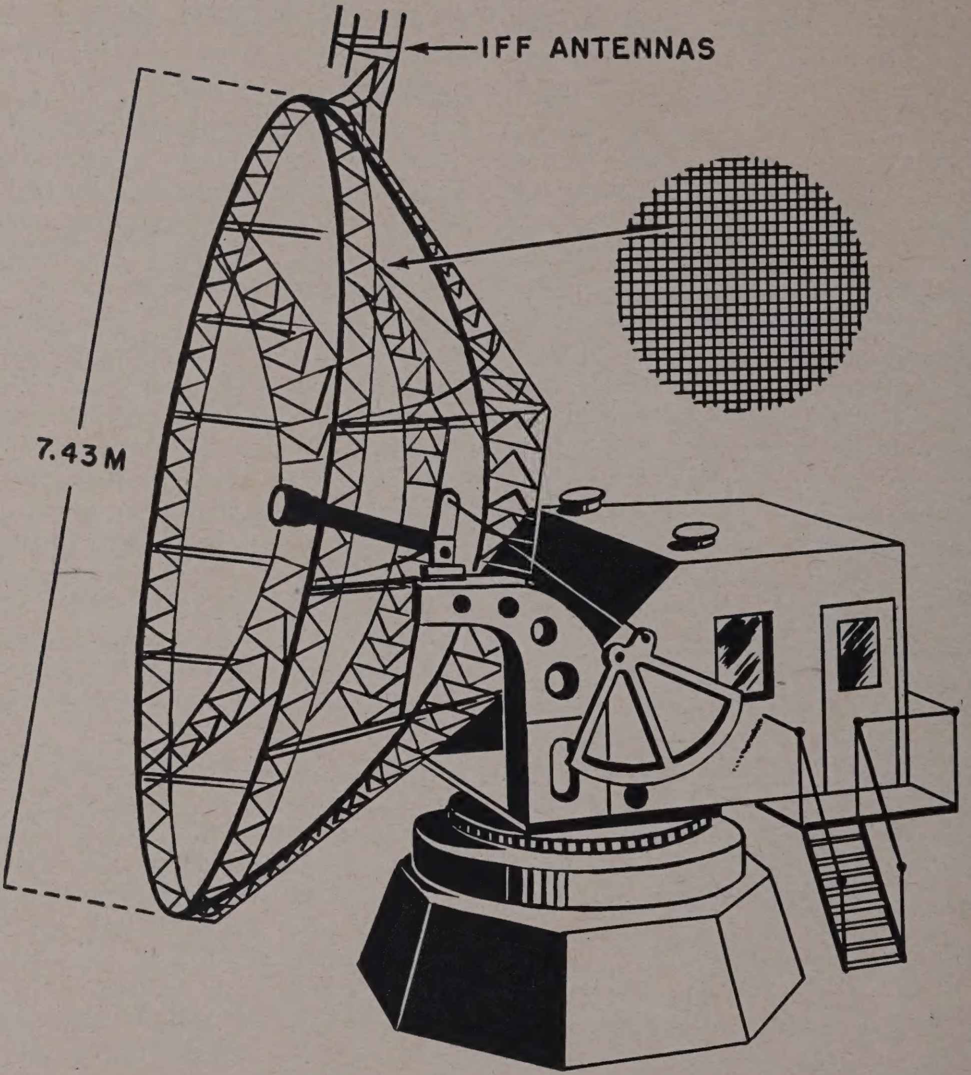

IFF ANTENNAS
7.43 M
TL47772

Figure 57. Giant Würzburg.